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THE FAMILY TUTOR

VOL. 6.

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PREFACE.

WITH the present Number of THE FAMILY TUTOR the Sixth Volume of the series is brought to a close; and we may now safely affirm that, in the whole history of periodical literature, we know of no publication more replete with useful information, or better suited for the family library, than the instructive series of portable and convenient-sized volumes which are now brought to a completion. In them are comprehended a great variety of interesting subjects connected with educational matters, as well as with the varied pursuits of the general student. From the commencement of the work, it was intended, by the conductors, that one important subject, in which the highest talents would be engaged, should form a prominent portion of each volume. Thus, in the First Volume, the science of GRAMMAR occupies the leading position. The Second Volume contains a complete treatise on NATURAL GEOGRAPHY; the Third embraces a popular view of GEOLOGY; and the Fourth is enriched with a series of Letters on the sublime Science of ASTRONOMY, treated in a familiar manner, and edited from the original work of Dr. Olmsted. The Fifth and Sixth Volumes are chiefly devoted to subjects of a scientific and popular character,—the leading articles being on NATURAL PHILOSOPHY and INORGANIC CHEMISTRY—the first by Professor Draper, and the second by Professor Silliman. They are each accompanied with such graphic illustrations and editorial notes as cannot fail to contribute most materially to their general value.

Independently of the treatises on Natural Philosophy and Inorganic Chemistry, in the present volume, our scholastic readers will find a great variety of ESSAYS on EDUCATION, and also many useful Treatises on the ENGLISH LANGUAGE AND LITERATURE, on NATIONAL HISTORY, and on the Study of EUCLID; with interesting Reviews and illustrative vignettes of each MONTH, Notices of Public GRAMMAR SCHOOLS, Lessons in FRENCH, Disquisitions on the BLOW-PIPE, and much interesting information connected with Educational and Scholastic matters.

PREFACE.

With this our Sixth Volume THE FAMILY TUTOR will be completed; but another Work, with somewhat loftier objects, will be published, under the title of ORR'S "CIRCLE OF THE SCIENCES," which we can cordially recommend to the readers of THE FAMILY TUTOR as a work adapted, in every respect, to promote the great objects of science and of general education, which the Editors of THE TUTOR, from its first establishment, have ever prominently kept in view. The "CIRCLE OF THE SCIENCES" will be issued in weekly numbers; and, though somewhat larger than THE TUTOR, will be published at precisely the same price, viz. Twopence per Number. The introductory portion, as well as the first number of the regular work, has already been issued.* Thus the Editors, in due course, will be enabled to give the completion of the article on "Natural Philosophy," embracing "Magnetism and Electricity," for which numerous engravings have been prepared; as well as the valuable supplementary treatise on "Organic Chemistry," written by Professor Silliman.

While many subjects which would have been suitable for the TUTOR will thus appear in the CIRCLE OF THE SCIENCES, others connected with the subject of Home Education will appear from time to time in THE FAMILY FRIEND,—a weekly serial of very extensive circulation, belonging to the same proprietors, and which has always been in some degree connected with the present Work.

Amidst these varied changes it only remains for the conductors to express their hopes that they shall still continue to merit the approbation and secure the kind patronage of their numerous friends and supporters.

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* For particulars, see the Prospectus attached to THE TUTOR cover.

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NATURAL PHILOSOPHY.

Second Division.

PROPERTIES OF LIGHT.—Optics.

CHAPTER XXXIV.

PROPERTIES OF LIGHT.

Theories of the Nature of Light—Sources of Light—Phosphorescence—Temperature of a red Heat—Effects of Bodies on Light—Passage in straight Lines—Production of Shadows—Umbra and Penumbra.

Having, in the last volume of the Family Tutor, successively treated of the general mechanical properties of gases, liquids, solids, and the laws of motion, we are now led to the consideration of certain agents or forces—light, heat, electricity. These, by many philosophers, are believed to be matter, in an imponderable state; they are therefore spoken of as imponderable substances. By others their effects are regarded as arising from motions or modifications impressed on a medium everywhere present, which passes under the name of THE ETHER.

Applying these views to the case of light, two different hypotheses respecting its constitution obtain. The first, which has the designation of the *theory of emission*, regards light as consisting of particles of amazing minuteness, which are projected by the shining body in all directions, and in straight lines. These, impinging eventually on the organ of vision, give rise to the sensation which we speak of as brightness or light. To the other theory, the title of *undulatory theory* is given; it supposes that there exists throughout the universe an ethereal medium, in which vibratory movements can arise somewhat analogous to the movements which give birth to sounds in the air; and these passing through the transparent parts of the eye, and falling on the retina, affect it with their pulsations, as waves in the air affect the auditory nerve, but in this case give rise to the sensation of light, as in the other to sound.

There are many different sources of light—some are astronomical and some terrestrial. Among the former may be mentioned the sun and the stars—among the latter, the burning of bodies, or combustion, to which we chiefly resort for our artificial lights, as lamps, candles, gas flames. Many bodies are phosphorescent; that is to say, emit light after they have been exposed to the sun or any shining source. Thus oyster-shells, which have been calcined with sulphur, shine in a dark place after they have been exposed to the light, and certain diamonds do the same. So, too, during processes of putrefaction, or slow decay, light is very often emitted, as when wood is mouldering, or meat is becoming putrescent. The source of the luminousness, in these cases, seems to be the same as in ordinary combustions; that is, the burning away of carbon and hydrogen under the influence of atmospheric air;—but, in certain cases, the functions of life give rise to an abundant emission of light, as in fireflies and glowworms; these continue to shine even under the surface of water, and there is reason to believe that the phenomenon, to a considerable extent, is subject to the volition of the animal.

All solid substances, when they are exposed to a certain degree of heat, become incandescent or emit light. When first visible in a dark place, this light is of a reddish colour; but as the temperature is carried higher and higher it becomes more brilliant, being next of a yellow, and lastly of a dazzling whiteness. For this reason, we sometimes indicate the temperature of such bodies, in a rough way, by reference to the colour they emit: thus we speak of a red heat, a yellow heat, a white heat. I have recently proved that all solid substances begin to emit light at the same degree of heat, and that this answers to 977° of Fahrenheit's thermometer; moreover, as the temperature rises the brilliancy of the light rapidly increases, so that at a temperature of 2600° it is almost forty times as intense as at 1900°. At these high temperatures an elevation of a few degrees makes a prodigious difference in the brilliancy. Gases require to be brought to a far higher temperature than solids before they begin to emit light.

Non-luminous bodies become visible by reflecting the light which falls on them. In their general relations, such bodies may be spoken of as transparent and opaque. By the former we mean those which, like glass, afford a more or less ready passage to the light through them; by the latter, such as refuse it a passage. But transparency and opacity are never absolute—they are only relative. The purest glass extinguishes a certain amount of the rays which fall on it, and the metals which are commonly looked upon as being perfectly opaque allow light to pass through them, provided they are thin enough. Thus gold leaf spread upon glass transmits a greenish-coloured light.

The rays of light, from whatever source they may come, move forward in straight lines, continuing their course until they are diverted from it by the interposition of some obstacle, or the agency of some force. That this rectilinear path is followed may be proved by a variety of facts. Thus, if we intervene an opaque body between any object and the eye, the moment the edge of that body comes to the line which connects the object and the eye, the object is cut off from our view. In a room into which a sunbeam is admitted through a crevice, the path which the light takes, as is marked out by the motes that float in the air, is a straight line.

By a ray of light we mean a straight line drawn from the luminous body, marking out the path along which the shining particles pass.

A shining body is said to radiate its light, because it projects its luminous particles in straight lines, like radii, in every direction, and these falling on opaque bodies, and being intercepted by them, give rise to the production of shadows.

If the light is emitted by a single luminous point, the boundary of the shadow can be obtained by drawing straight lines from the luminous point to every point on the edge of the body, and producing them. Thus, let *a*, Fig. 208, be the luminous point, *b c* the opaque body; by drawing the lines *a b*, *a c*, and producing them to *d* and *e*, the boundary and figure of the shadow may be exhibited.

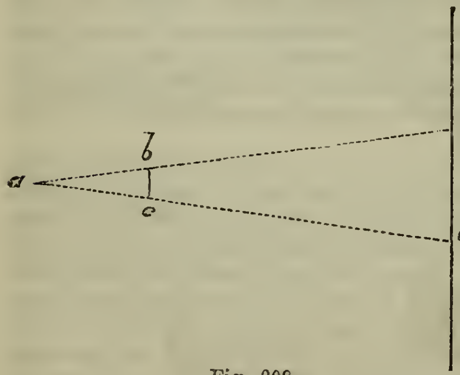

Fig. 208.

But if the luminous body, as in most instances is the case, possesses a sensible magnitude; if it is, for example, the sun or a flame, an opaque body will cast two shadows, which pass respectively under the names of the *umbra* and *penumbra*—the former being dark and the latter partially illuminated. This may be illustrated by Fig. 209, in which *a b* is the flame of a candle, or any other luminous source, having a sensible magnitude, *c d* the opaque body. Now the straight lines, *a c f*, *a d h*, drawn from the top of the flame to the edges of the opaque body and produced, give the shadow for that point of the flame; and the lines *b c e*, *b d g*, drawn in like manner from the bottom of the flame, give the shadow for that point. But we see that the space between *g* and *h*, which belongs to the shadow for the top of the flame, is not perfectly dark, because it is so situated as to be partially illuminated by the bottom of the flame—and a similar remark may be made as respects the space *f e*, which receives light from the top of the flame. But the remaining space, *f g*, receives no light whatever—it is totally dark—and we therefore call it the *umbra*, while the partially-illuminated regions, *f e* and *g h*, are the *penumbra*.

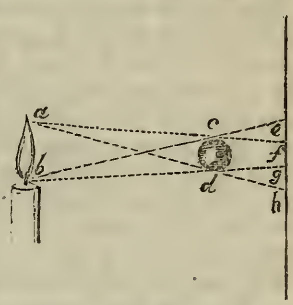

Fig. 209.

CHAPTER XXXV.

OF THE MEASURES OF THE INTENSITY AND VELOCITY OF LIGHT.

Conditions of the Intensity of Light—Of Photometric Methods—Rumford's Method by Shadows—Ritchie's Photometer—Difficulties in Coloured Lights—Masson's Method—Velocity of Light determined by the Eclipses of Jupiter's Satellites—The same by the Aberration of the Fixed Stars.

By Photometry* we mean the measurement of the brilliancy of light—an operation which can be conducted in many different ways.

It is to be understood that the illuminating power of a shining body depends on several circumstances. First, upon its distance—for near at hand the effect is much greater than far off—the law for the intensity of light in this respect being—that the brilliancy of the light is inversely as the square of the distance. A candle two feet off gives only one-fourth of the light that it does at one foot; at three feet it gives only one-ninth, &c. Secondly, it depends on the absolute intensity of the luminous surface: thus we have seen that a solid, at different degrees of heat, emits very different amounts of light; and in the same way the flame of burning hydrogen is almost invisible, and that of spirits of wine is very dull when compared with an ordinary lamp. Thirdly, it depends on the area or surface the shining body exposes, the brightness being greater according as that surface is greater. Fourthly, in the absorption which the light suffers in passing the medium through which it has to traverse—for even the most transparent obstructs it to a certain extent. And lastly, on the angle at which the rays strike the surface they illuminate, being most effective when they fall perpendicularly, and less in proportion as their obliquity increases.

The first and last of the conditions here mentioned, as controlling the intensity of light—the effect of distance and of obliquity—may be illustrated as follows:—

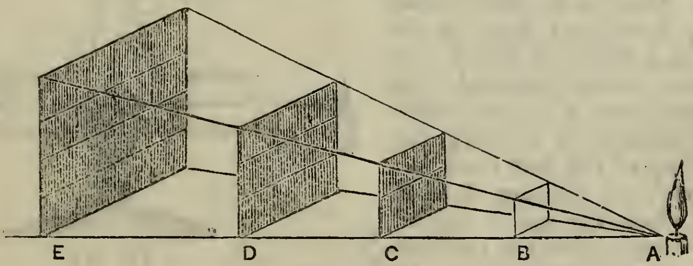

Fig. 210.

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* This term is derived from the two Greek words, *phose* (φως), light, and *metron* (μετρον), a measure.

1*st*. That the intensity of light is inversely as the squares of the distance. Let B, Fig. 210, be an aperture in a piece of paper, through which rays coming from a small illuminated point, A, pass; let these rays be received on a second piece of paper, C, placed twice as far from A as is B, it will be found that they illuminate a surface which is twice as long and twice as broad as A, and therefore contains four times the area. If the paper be placed at D, three times as far from A as is B, the illuminated space will be three times as long and three times as broad as A, and contain nine times the surface. If it be at E, which is four times the distance, the surface will be sixteen times as great. All this arises from the rectilinear paths which the diverging rays take, and therefore a surface illuminated by a given light will receive, at distances represented by the numbers 1, 2, 3, 4, &c., quantities of light represented by the numbers 1, $\frac{1}{4}$, $\frac{1}{9}$, $\frac{1}{16}$, &c., which latter are the inverse squares of the former numbers.

2*d*. That the intensity of light is dependent on the angle at which the rays strike the receiving surface, being most effective when they fall perpendicularly, and less in proportion as the obliquity increases. Let there be two surfaces, D C and E C, Fig. 211, on which a beam of light, A B, falls on the former perpendicularly, and on the latter obliquely—the latter surface, in proportion to its obliquity, must have a larger area to receive *all* the rays which fall on D C. A given quantity of light, therefore, is diffused over a greater surface when it is received obliquely, and its effect is correspondingly less.

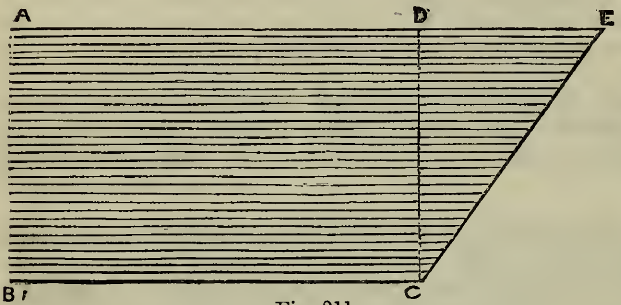

Fig. 211.

To compare different lights with one another, Count Rumford invented a process which goes under the name of the method of shadows. The principle is very simple. Of two lights, that which is the most brilliant will cast the deepest shadow, and with any light the shadow which is cast becomes less dark as the light is more distant. If, therefore, we wish to examine experimentally the brilliancy of two lights on Rumford's method, we take a screen of white paper, and setting in front of it an opaque rod, we place the lights in such a position that the two shadows arising shall be close together, side by side. Now the eye can, without any difficulty, determine which of the two is darkest; and by removing the light, which has cast it to a greater distance, we can, by a few trials, bring the two shadows to precisely the same degree of depth. Now measure the distances of the two lights from the screen, and the illuminating powers are as the squares of those distances.

Ritchie's photometer is an instrument for obtaining the same result; not, however, by the contrast of shadows, but by the equal illumination of surfaces. It consists of a box, *a b*, Fig. 212, six or eight inches long, and one broad and deep, in the middle of which a wedge of wood, *f e g*, with its angle, *e*, upward, is placed. This wedge is covered over with clean white paper, neatly doubled to a sharp line at *e*. In the top of the box there is a conical tube, with an aperture, *d*, at its upper end, to which the eye is applied, and the whole may be raised to any suitable height by means of the stand *c*. On looking down through *d*, having previously placed the two lights, *m n*, the intensity of which we desire to determine on opposite sides of the box, they illuminate the paper

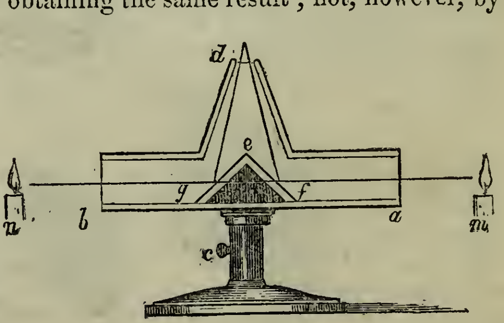

Fig. 212.

surfaces exposed to them, *e f* to *m*, and *e g* to *n*, and the eye, at *d*, sees both those surfaces at once. By changing the position of the lights, we eventually make them illuminate the surfaces equally, and then measuring their distances from *e*, their illuminating powers are as the squares of those distances.

It is not possible to apply either of these methods in a satisfactory manner, where, as is unfortunately often the case, the lights to be examined differ in colour. The eye can form no judgment whatever of the relation of brightness of two surfaces when they are of different colours; and a very slight amount of tint completely destroys the accuracy of these processes. To some extent, in Ritchie's instrument, this may be avoided, by placing a coloured glass at the aperture, *d*.

A third photometric method has recently been introduced; it has great advantages over either of the foregoing; and difference of colour, which in them is so serious an obstacle, serves in it actually to increase the accuracy of the result. The principle on which it is founded is as follows: If we take two lights, and cause one of them to throw the shadow of an opaque body upon a white screen, there is a certain distance to which, if we bring the second light, its rays, illuminating the screen, will totally obliterate all traces of the shadow. This disappearance of the shadow can be judged of with great accuracy by the eye. It has been found that eyes of average sensitiveness fail to distinguish the effect of a light when it is in presence of another sixty-four times as intense. The precise number varies somewhat with different eyes; but to the same eye it is always the same. If there be any doubt as to the perfect disappearance of the shadow, the receiving screen may be agitated or moved a little. This brings the shadow, to a certain extent, into view again. Its place can then be traced, and, on ceasing the motion, the disappearance verified.

When, therefore, we desire to discover the relative intensities of light, we have merely to inquire at what distance they effect the total obliteration of a shadow, and their intensities are as the squares of those distances. I have employed this method for the determination of the quantities of light emitted by a solid at different temperatures, and have found it very exact.

Light does not pass instantaneously from one point to another, but with a measurable velocity. The ancients believed that its transmission was instantaneous, illustrating it by the example of a stick, which, when pushed at one end, simultaneously moves at the other. They did not know that even their illustration was false; for a certain time elapses before the farther end of the stick moves; and, in reality, a longer time than light would require to pass over a distance equal to the length of the stick. But, in 1676, a Danish astronomer, Roemer, found, from observations on the eclipses of Jupiter's satellites, that light moves at the rate of about 192,000 miles in one second.

This singular observation may be explained as follows: Let S, Fig. 213, be the sun, E the earth, moving in the orbit E E′, as indicated by the arrows; let J be Jupiter, and T his first satellite, moving in its orbit round him. It takes the satellite 42 hours, 28 minutes, 35 seconds, to pass from T to T′—that is to say, through the planet's shadow. But, during this period of time, the earth moves in her orbit, from E to E′, a space of 2,880,000 miles. Now, it is found, under these circumstances, that the emersion of the satellite is 15 seconds later than it should have been. And it is clear that this is owing to the fact that the light requires 15 seconds to pass from E to E′ and overtake the earth. Its velocity, therefore, in one second, must be 192,000 miles.

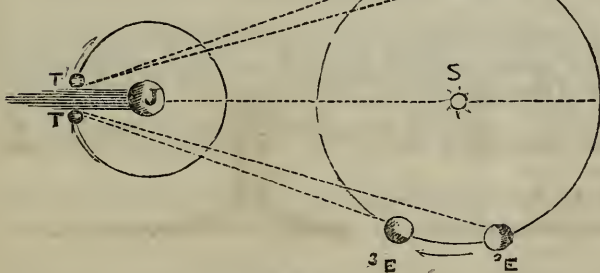

Fig. 213.

This beautiful deduction was corroborated by Dr. Bradley, in 1725, upon totally different principles, involving what is termed the aberration of the stars. The principle, which is somewhat difficult to explain, is clearly illustrated by Eisenlohr as follows: Let M N represent a ship, whose side is aimed at point-blank by a cannon at *a*. Now, if the vessel were at rest, a ball discharged in this manner would pass through the points *b* and *c*, so that the three points, *a*, *b*, and *c*, would all be in the same straight line. But if the vessel itself move from M towards N, then the ball which entered at *b* would not come out at the opposite point, *c*, but at some other point, *d*, as much nearer to the stern as is equal to the distance gone over by the vessel, from M to N, during the time of passage of the ball through her. The lines *b c* and *b d*, therefore, form an angle at *b*, whose magnitude depends on the position of *b c* and *b d*. The greater the velocity of the ball, as compared with the ship, the less the angle. Next, for the ship substitute in your mind the earth, and for the cannon any of the fixed stars; let the velocity, *b c*, of the cannon-ball now stand for that of light, and let *d c* be the velocity of the earth in her orbit. The angle, *d b c*, is called the angle of aberration. It amounts to $20\frac{1}{4}$ seconds for all the stars; for they all exhibit the same alteration in their apparent position, being more backward than they really are in the direction of the earth's annual motion, as Bradley discovered. By a simple trigonometrical calculation, it appears from these facts that the velocity of light is 195,000 miles per second, a result nearly coinciding with the former.

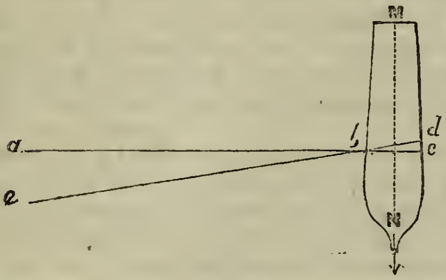

Fig. 214.

CHAPTER XXXVI.

REFLEXION OF LIGHT.

Different kinds of Mirrors—General Law of Reflexion—Case of Parallel, Converging, and Diverging Rays on Plane Mirrors—The Kaleidoscope—Properties of Spherical Concave Mirrors—Properties of Spherical Convex Mirrors—Spherical Aberration—Mirrors of other Forms—Cylindrical Mirrors.

When a ray of light falls upon a surface, it may be reflected, or transmitted, or absorbed.

We therefore proceed to the study of these three incidents, which may happen to light, commencing with reflexion.

Reflecting surfaces in optics are called mirrors; they are of various kinds, as of polished metal or glass. They differ also as respects the figure of their surfaces, being plane, convex, or concave; and again they are divided into such as are spherical, parabolic, elliptical, &c.

The general law which is at the foundation of this part of optics—the law of reflexion—is as follows:—

The angle of reflexion is equal to the angle of incidence; the reflected ray is in the opposite side of the perpendicular; and the perpendicular, the incident, and the reflected rays are all in the same plane.

Thus let *i*, Fig. 215, be the reflecting surface; *b i* a perpendicular to it at any point, *n i* a ray incident on the same point; the path of the reflected ray under the foregoing law will be *i d*; such, that it is on the opposite side of the perpendicular to the incident ray, that *n i*, *i p*, and *i d*, are all in the same plane, and that the angle of incidence, *n i p*, is equal to the angle of reflexion, *i p d*.

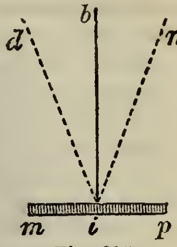

Fig. 215.

Reflexion from mirror surfaces may be studied under three divisions: reflexion from plane, from concave, and from convex mirrors.

When parallel rays fall on a plane mirror, they will be reflected parallel, and divergent and convergent rays will respectively diverge and converge at angles equal to their angles of incidence.

When rays diverging from a point fall on a mirror, they are reflected from it in such a manner as though they proceeded from a point as far behind it as it is in reality before it. This principle has already been explained in Chapter XXXI. It is illustrated in Fig. 216. Thus, if from the point *a* two rays, *a b*, *a c*, diverge, they will, under the general law, be respectively reflected along *b d*, *c e*; and if these be produced they will intersect at a', as far behind the mirror as *a* is before it. The point a' is called the virtual focus.

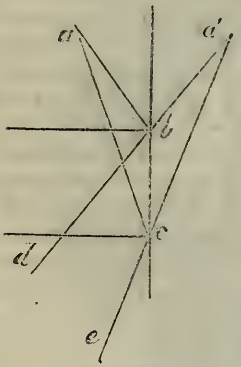

Fig. 216.

From this it appears that any object seen in a plane mirror appears to be as far behind it as it is in reality before it.

If an object is placed between two parallel plane mirrors, each will produce a reflected image, and will also repeat the one reflected by the other. The consequence is, therefore, that there is an indefinite number of images produced, and in reality the number would be infinite, were the light not gradually enfeebled by loss at each successive reflexion.

The kaleidoscope is a tube containing two plane mirrors, which run through it lengthwise, and are generally inclined at an angle of 60°. At one end of the tube is an arrangement by which pieces of coloured glass or other objects may be held, and at the other there is a cap with a small aperture. On placing the eye at this aperture the objects are reflected, and form a beautiful hexagonal combination; their position and appearance may be varied by turning the tube round on its axis.

The principle upon which the kaleidoscope is constructed is the multiplication of the reflection of an object caused by placing it between two mirrors inclined towards each other at any angle, but usually at 60°. This instrument was invented or revived by Sir David Brewster, who took out a patent for it in 1817. The accompanying figure represents two mirrors inclined towards each other at an angle, A B C, having an object, O P, placed between them. The consequence of this arrangement is, that several images will be observed arranged within the circumference of a circle. Thus we observe in the diagram that the image O P, in the mirror A C, is *p o*, while its image in B C is $o' p'$; and therefore the reflection of *p o* in B C will be $o'' p''$, while the image of $o' p'$ in A C will be $p' o'$. It therefore appears that $p'' o''$ is the image of both P″ O″ in the mirror *b* C, and of $o' p'$ in the mirror *a* C, one of the images covering the other, if the angle B C A be *b* (or the sixth part of a circle) as in the diagram. If the angle be greater or less, the image p'' O″ will be twofold.

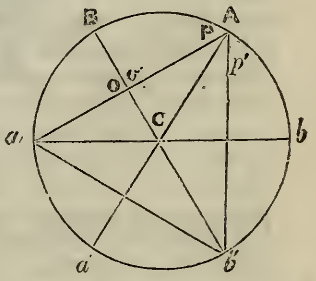

Fig. 217.

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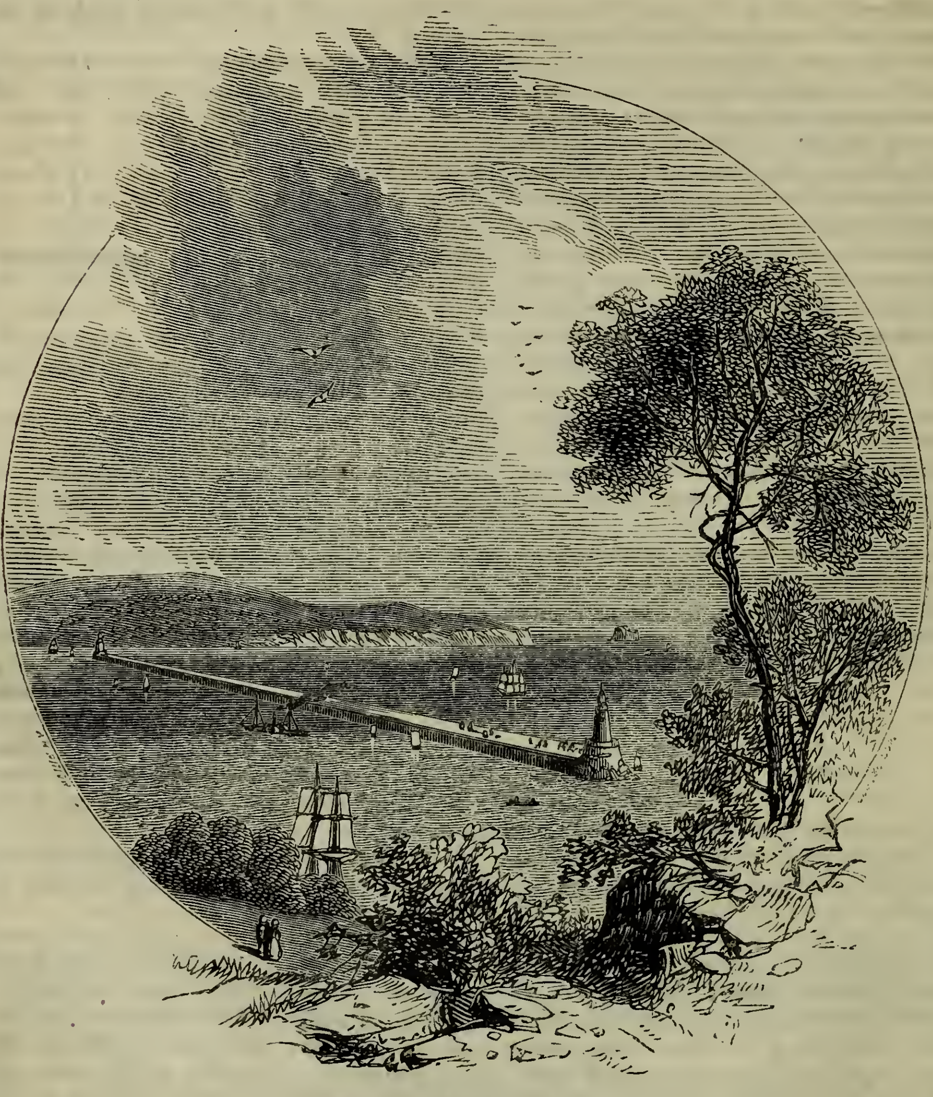

THE BREAKWATER, PLYMOUTH.

THE BREAKWATER, PLYMOUTH.

We shall not omit an occasional notice of the wonderful achievements of art in our country. Such subjects may be properly introduced into the pages of the Family Tutor as incentives to youth, for the career of usefulness and invention is open to all.

The south-west corner of Devonshire is admirably suited for a great naval station. Few portions of our coasts equal it in the facilities offered for works of such a description. Plymouth Sound may be viewed as an estuary to the Tamar and the Plym. At any rate, we there find a noble expanse of water, sheltered in on the east, west, and north from winds and storms. As we approach the northern portion of this harbour or sound, we find it narrowed by the promontory of Mount Batten on the east, and the still bolder promontory of Mount Edgcumbe on the west. Arrived at the northern limit, where the citadel and Hoe of Plymouth form a termination to the Sound due northward, we find the inlet of the Catwater in the north-east, leading to the quays of Plymouth and the river Plym; while in the north-west we have the remarkable passage or strait between Cremill Point and Mount Edgcumbe. Having passed through this strait, we come at once into the magnificent harbour of the Hamoaze, where a secure anchorage is found for whole fleets of men-of-war; here, too, are seen the extensive works of the Devonport Dockyard, Victualling-yard, Steam Dock, and other government establishments. Proceeding onwards towards Saltash, we come to the River Tamar, the lower portion of which is so broad as to form a harbour for three miles. The bays and inlets all around and within the Sound and the Hamoaze are so numerous as to afford remarkable facilities for the construction of works connected with ship-building, fortifications, naval defence, and maritime commerce.

The Breakwater, represented in the accompanying engraving, demands to be noticed. A truly great work is this; perhaps the greatest work of its kind in the world. It seems strange to spend a million and a half sterling in throwing huge stones into the sea; yet there can be no question that the money has been well laid out, because safety to hundreds of vessels has been secured thereby.

In order to understand the necessity for and the nature of this Breakwater, we must look a little closely at Plymouth Sound. This Sound is bounded on the east by a portion of the Devonshire coast, on the west by the Cornish coast, on the north by the towns of Devonport and Plymouth, and on the south by the open sea. It is three miles across at the widest part, and about the same in depth. The coast on both sides, except at Cawsand Bay, which is on the Cornish side, is rocky and abrupt. The Hamoaze and the Catwater used to be exposed to the heavy sea which rolled into the Sound with gales from the south, and great damage was done at various times; hence it was conceived that if a great embankment were thrown across a portion of the entrance to the Sound, it would break the force of the sea, while ample room might be left at the two ends for vessels to enter and quit the Sound. In 1812 the works for such a breakwater were commenced, and for nearly forty years they have been continued. The expenditure has now reached within a fraction of £1,500,000, and there is still a little more work to be done to it.

The Breakwater may be thus described:—It is a straight line of stonework, with two wings or arms inclined a little inwards towards the Sound. The straight portion is about 1000 yards in length, and the two wings 350 yards each; making up the total length to about a mile. The width of the line of stonework at the bed of the sea varies from 300 to 400 feet; whereas it slopes so rapidly upwards that the breadth at high-water mark is only fifty feet. The top is a flat horizontal surface, elevated a small distance above the surface of the water. The total depth varies from forty to eighty feet. The mode of forming it was singular. Mr. Rennie formed the plan, and carried it out in spite of all opposition and difficulties. This plan consisted in hurling into the sea masses of stone weighing from one ton to ten tons each, sufficiently heavy to resist the force of waves, tides, and currents. A promontory of campact close-grained marble, belonging to the Duke of Bedford, was purchased as a storehouse of materials for the sum of £10,000. This promontory is situated at the north-east corner of the Sound, at a place called Oreston, where the Plym joins the Catwater. Quarries were opened at this spot, and for many years the business of quarrying was carried on. When Baron Dupin was visiting the naval depôts of England, he was struck, among other things, by the magnitude of the operations at Oreston. He says—"The sight of these operations (which he had just described); those enormous masses of marble which the quarrymen strike with heavy strokes of their hammers; and those aërial roads of flying bridges which serve for the removal of the superstratum of earth; those lines of cranes all at work at the same moment; the trucks all in motion; the arrival and the loading and the departure of the vessels; all this forms one of the most imposing sights that can strike a friend of the great works of art. At fixed hours, the sound of a bell is heard, in order to announce the blasting of the quarry. The operations instantly cease on all sides, all becomes silence and solitude; this universal silence renders still more imposing the noise of the explosion, the splitting of the rocks, their ponderous fall, and the prolonged sound of the echoes." The huge blocks of marble, extricated from the quarries, were conveyed in trucks along iron railways to quays, where they were received in vessels built expressly for this purpose. On arriving over the line of the Breakwater, a sort of trapdoor was opened in the vessel, and the load of stone fell into the sea, where it lay upon and among the stones previously thrown. Thus days, weeks, months, years, passed away while these Herculean works were being carried on. All the lower stones were left to settle as they might; but the upper layers consist of smooth masonry, better calculated to resist the action of waves. At the western end is a lighthouse, an elegant structure of granite, recently completed; it is about fifty-five feet high, by fourteen in diameter at the base; at the top is a large lantern, through which is exhibited a white light towards the north, and a red light towards the south.

Bravely has the Breakwater done its work. In 1817 and in 1824 it was visited by storms which, had not the Breakwater been there, would have brought awful destruction on the vessels within the harbour; as it was, some of the surface stones were loosened and washed away, but the main structure remained wholly uninjured. The value of the Breakwater is wholly shown by negative results: ships are *not* now driven on shore within the Sound and Hamoaze; but this negative result has a very positive effect on the national resources, one for which we may thank the Admiralty and Sir John Rennie.

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ON THE STUDY OF EUCLID.

I. INTRODUCTORY OBSERVATIONS.

Euclid is the name most commonly given to the system of Elementary Geometry of which that illustrious ancient was the author or compiler. We speak of the study of Euclid just as we speak of the study of Newton, meaning, in the one case, the study of the "*Elements*," and, in the other, the study of the "*Principia.*"

It is a remarkable fact, as well as a most conclusive proof of the singular excellence of the *Elements*, that no written language has hitherto been discovered which is not enriched by the possession of this work; and even "the semi-barbaric dialect of a Tartar horde," as Playfair expresses it, numbers *Euclid* among its scanty literary treasures.

It is not likely that a work thus having the intellectual suffrage of the whole world should ever be superseded; yet it is hard to believe that while every other subject of human study is becoming more and more accessible; that while improved methods of exposition and instruction are so smoothing down the rugged asperities of science, that what were formidable difficulties in one age, became easy school-boy exercises in the next,—we say, it is hard to believe that, notwithstanding such marked and almost universal progress, the mind should have stood absolutely still as respects geometry; insomuch that, just as its principles were systematically expounded in the schools of Greece more than two thousand years ago, so should they be taught unchanged in form, unaltered in arrangement, unabridged and unextended, in our places of education at the present day.

Now, much as we admire *Euclid*, we are free to confess that we see a good deal of prejudice in this strict and uncompromising adherence to the *Elements*. If it be true that no human production can be perfect, even Euclid's Elements are not an exception;* though Dr. Swinton, "the great restorer of Euclid," made this exception an article of his scientific faith; for, although he himself removed many blemishes, and supplied many defects, he indignantly repudiated all claim to personal merit on the score of correcting or improving his author—he merely claimed the credit of having restored him in his integrity, where "unskilful editors" had vitiated his reasonings, and corrupted his text. It is truly amusing to observe, as one flaw after another discovers itself to his penetration, how angry he becomes with poor *Theon,* or some other imaginary mutilator of the Elements. "Theon, or some other editor, that he might save himself trouble, has inserted the 10th def. of this Book to serve instead of demonstration, which was very ignorantly done." "The words, 'in the same manner,' &c., are left out, as the addition of some ignorant editor." "The demonstration of this has been spoiled by some unskilful hand," and so on.

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* This dogma, however, like most popular adages, seems to us to require limitation. As respects the works of our *hands*, it is no doubt true, but not necessarily true as to our *intellectual* performances. The blemishes, noticed above, in Euclid, were not the necessary consequences of intellectual short-coming, or incapacity, since other minds have removed them; they were mere oversights or mistakes, corrected as soon as discovered or pointed out. We are, of course, aware that the celebrated 12th axiom is still considered a stumbling-block; but it ceases to present an obstacle when transferred to a more appropriate place in the system, as we shall endeavour to show hereafter. And we may take this opportunity of announcing our intention of shortly publishing a condensed *Course of Mathematical and Physical Science*, expressly for school-boys and young persons who may not have the advantage of oral instruction. The work will be limited to *two* volumes, of between three and four hundred pages each—one, on the Elements of Mathematics, and the other, on the Elements of Natural Philosophy—each part comprising a distinct subject—at an exceedingly low charge. We need scarcely say that we shall strive to unite scientific rigour with the utmost attainable simplicity.

It is our intention, in a few short papers, to submit to our readers—teachers as well as learners—some observations and directions as to the most profitable manner of studying the great work to which we have been referring. We think that Euclid is sometimes taken up with erroneous expectations as to what it teaches, and read with a pliant docility of mind—a passive acquiescence in the dicta of the teacher—which Euclid himself would condemn. It is a very undesirable thing to commence any study with an erroneous impression as to its objects, and equally so to prosecute it in a wrong spirit.

A youth, destined ultimately for some mechanical or scientific occupation, is told—and properly told—that, to excel in his calling, he must study Euclid; this study is usually associated in his mind with a case of mathematical instruments, with scales, compasses, parallel-rulers, &c. Now, without expressly *forbidding* these things, it is of importance that he should know at the outset, that, for aught that appears to the contrary, Euclid never handled or even saw compasses, parallel-rulers, &c., in his life. It is certain that he gives no countenance to the use of any such mechanical contrivances in his work. Had Euclid been asked, there is no doubt that he would have declared his inability to describe a circle, and even to draw a straight line. What *we* call *practical geometry* Euclid was entirely regardless of; indeed, the application of geometry to the practical business of life was viewed by the ancient geometricians rather as a degradation of the purely intellectual science they cultivated, than as enhancing its value; and we accordingly find that but few of Euclid's *problems,* or practical constructions, are such as a skilful workman would follow.

Important and extensive as are the practical applications of geometry, it should nevertheless be borne in mind that the *Elements* would have existed, just as they now do, if these applications had never been thought of. The availability of geometry in practice is merely a contingent and accidental circumstance, uncontemplated by the ancient geometricians, just as their theory of the conic sections was elaborated without any prospective regard to the future demands of physical astronomy, or to the discoveries of Newton.

And it is right to contemplate geometry under this purely intellectual aspect, and to study it as a strictly abstract science. Practical operations are all more or less imperfect. There are imperfections of vision, of the hand, of the instruments employed. Pure Euclidean geometry tolerates no such imperfections, however minute or unimportant they may be in a practical point of view. The circle of Euclid is a *perfect* circle—such a circle, in fact, as no human being ever formed. In like manner, the straight line of Euclid is vigorously what it is affirmed to be—*perfectly* straight, and *perfectly* breadthless. We were therefore fully warranted in saying, as above, that Euclid could not describe a circle, nor draw a straight line: he has not, indeed, attempted to do either; the marks and diagrams which he exhibits to the eye, in connection with his reasonings, are nothing more than the outward symbols of what *actually exists in the mind alone.* And the truths of geometry become applicable to visible and tangible squares, circles, &c., only on the supposition or *assumption* that they are perfect copies of our intellectual conceptions of these things; and thus a very able writer on Logic and Mental Philosophy (Mr. Stuart Mills) denies to the lines and figures of geometry, the perfection here contended for. Assuming that all our conceptions of form originate in our contemplation of outward objects, which is, no doubt, true, he maintains that our ideas of squares, circles, &c., are only copies of the confessedly imperfect forms presented to our eyes. We would submit, however, that the mind can conceive, what it may surpass the powers of the hand to execute; that we can *imagine* a perfection which art cannot attain. A mere approximation to the perfect form—which is all that can be presented to the eye—will suggest the practically-unattainable perfection to the mind; and it may be safely affirmed that the very infirmity of our visual organs contributes to this perfection; since defects, too minute to be visible in the outward object, cannot possibly accompany the mental impression of that object.

We have thought it right, in these introductory remarks, thus to state broadly, and we hope unambiguously, what the subject-matter of geometry really is. The objects with which it deals, and to which its reasonings are applied, are our perfect mental conceptions of figure, and not the imperfect representations which, to help these conceptions, are traced upon the paper. This is no bar to the practical applications of the science. Whether a tangible square be perfect or imperfect is of no moment, practically speaking, so long as its imperfections are undiscoverable by the senses; inasmuch as the rigorous conclusions of geometry may be applied to it without practical or appreciable error. In our next paper we shall consider the basis upon which the entire structure of geometry rests—a basis so simple that a child might lay the foundation-stones; yet supporting a fabric which, though so extensive, is, at the same time, so secure, that the most powerful intellect cannot disturb its stability. We need scarcely say that we allude to the axioms and postulates of the science; and, in connection with the consideration of these, we shall take occasion to offer some suggestions as to the proper frame of mind in which Euclid should be studied.

We earnestly call the attention of our pupils to this interesting and deeply-absorbing science, for it is calculated to waken and mature the mind, and imbue it with sterling principles. It is wrong to suppose that because a science is difficult to be understood, the means for attaining such knowledge should be neglected. By mastering what the world might consider tedious and uninteresting, we arrive at the truly wonderful and beautiful.

PRACTICAL LESSONS IN DRAWING.

SIXTH LESSON.*

We have now to consider the subject of "Outline," a most important one to a draughtsman.

When the great Italian painter exclaimed, "Give me a correct outline, and you may fill it up as you please," he did not mean to carry his observation to the extreme that many persons have imagined; he wished to impress upon the minds of young artists the importance of having a correct outline; for without it, all the shading and filling up, however well executed, is only thrown away.

A simple perfect outline is more valuable than an imperfect one, worked up with all the skill of a Vandyke, Wilkie, or Landseer.

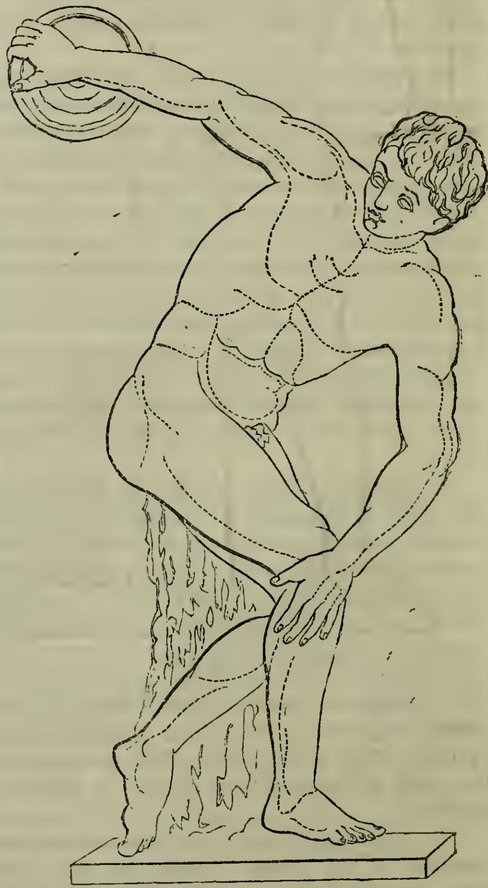

Fig. 26. The Quoit-thrower.

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* Continued from the Fifth Volume of "Family Tutor."

Many persons assert that the shading and filling up will hide some of the defects in a bad outline; but be assured that such advice is not only wrong, but highly injurious to tyros in the art of drawing, for opinions such as this are apt to undermine its right principles, and make beginners careless.

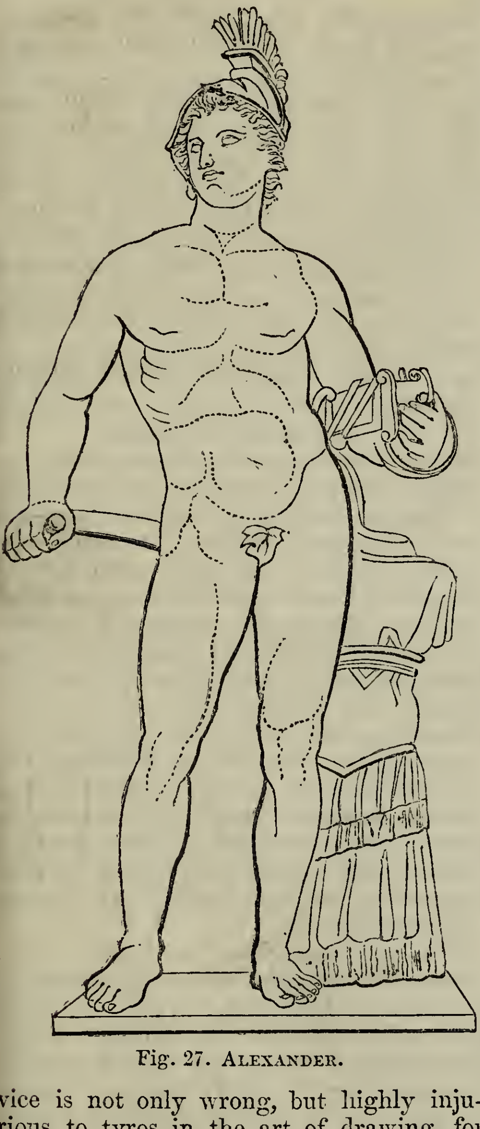

Fig. 27. Alexander.

Do you really know what is meant by outline? We presume you do not; nay, we are almost certain that you do not! It is useless to waste time in listening to a hundred definitions; we will therefore proceed at once to the point. Outline signifies the contour, or the line by which any figure is defined, being, in fact, the extreme or boundary line of an object. It is the line that determines form. For example—the outline of an apple would not, if correct, convey an impression to your mind that it was intended for an orange or a pear; and if you look at figs. 22, 24, and 25 (page 374, Vol. V., Family Tutor), you could not imagine that they were like the ordinary jugs in use.

Outline may be said to be the skeleton or anatomy of objects; at least it bears the same relations to them.

Outline cannot be formed without the aid of curved and straight lines (see Lesson III. p. 229, vol. v.); and in illustration of this, we beg to call the attention of our pupils particularly to figs. 26 and 27. The former represents the statue of the quoit-thrower of Myron, and the latter the statue of Alexander, by Gabius, after that of Lysippus, in the Louvre. They are both admirable studies for outline, particularly the latter, which exhibits gracefulness, courage, and strength, the muscles being admirably expressed without the aid of shading.

Of course, as you are now able to form lines of all kinds, in any direction, and of any reasonable length, you are already in possession of the alphabet of outline, and the rest depends upon yourself—for without constant application and attention you can never succeed.

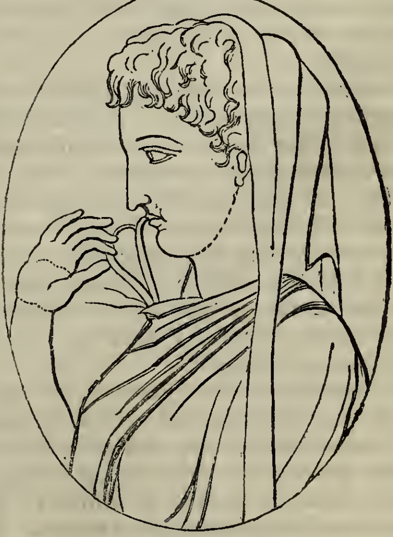

Fig. 28. Psyche.

Never be absurd enough to delude yourself, while you think that you are deceiving your relations or friends, *by tracing outlines against a window.* The practice cannot be too highly condemned, because it is contrary to art, honour, and good sense; and so long as you continue the system, it will be impossible for you to depend upon yourself.

All marks or lines that assist in expressing the character of the design, may be considered as belonging to outline.

There are many methods of producing effects by means of outline, besides adhering to the variations of form in the figures. For example—the lines used to express drapery should be flowing, continuous, and generally of variable breadth; those used for the flesh or for some kinds of fruit should partake of the same character; hard substances, such as armour, statuary, &c., should be expressed by uniform lines of a fine character; and foliage should be drawn boldly, with occasional dark touches, and with a tremulous lateral motion of the hand. The figure in page 13, taken from a gem, representing the bust of Psyche, will assist the pupil in comprehending our remarks upon drapery and flesh. When we treat of the human form, we shall refer to these figures again.

Never jag your lines by making them by fits and starts; let the motion of your hand be free and uninterrupted, so as to form a continuous line; for if the pencil is removed from the paper, a line like a saw will be the result.

We need not remind our pupils that there are extremes of outline as in other things; the one is too great a uniformity of line, the other too great a variation of breadth of line. If the subject is intended to be *finished* in outline, the pupil should strengthen one side more than the other; and we recommend that the outline etchings issued by the "Art-Union of London," which are excellent compositions, should be carefully studied and copied.

If the subject is to be shaded, the outline should be lightly, and not too firmly, drawn.

We must remind the student in drawing, that to give a correct delineation of the human figure it is indispensable to have some knowledge of muscular action. It is necessary that all the muscles, their purposes and functions, should be well understood; nor must osteology, or the bones of the skeleton, be neglected.

LESSONS IN FRENCH.*

THE PRONOUN.

The pronoun is a word which takes the place of a noun. Although this definition is applicable to some words called pronouns, yet there are some among them which would be better called adjectives, because they are never employed without being joined to nouns; but we shall keep this denomination for all, because they are generally qualified by that appellation, and sometimes clearness is preferable to precision.

The pronouns are of great service in languages; they not only save repetitions which would be insupportable and hard, but they spread over the style a clearness, animation, variety, and grace, which would not exist without their assistance.

In this passage, for instance, which we extract from the works of the Abbé Girard:

The grammar ought to follow the genius of the language of which it treats; its method ought to be clear and facile; it should not omit any of the laws consecrated by good practice; it should be definite, precise, and illustrated by examples, so that ignorant people may learn it, and the learned may approve it.—Il faut que la grammaire soit conduite par le génie de la langue qu'*elle* traite; que la méthode *en* soit nette et facile; qu'*elle* n'omette aucune des lois consacrées par l'usage; et que tout *y* soit exactement défini, ainsi qu'éclairé par des exemples, afin que les ignorants puissent *l'*apprendre, et que les savants *lui* donnent *leur* approbation.

The words *elle, en, y, l', lui, leur,* are pronouns, which replace the nouns *grammaire* and *savant.* If, instead of them, we repeat the words themselves, the sentence is not tolerable, and presents the most ridiculous specimen of style; as, Il faut que la *grammaire* soit conduit par le génie de la langue que le *grammaire* traite; que la méthode de la *grammaire* soit nette et facile; que la *grammaire* n'omette aucune des lois consacrées par l'usage; et que tout dans la *grammaire* soit défini, ainsi qu'éclairé par des exemples, afin que les ignorants puissent apprendre al *grammaire,* et que les savants donnent à al *grammaire* l'approbation des *savants.*

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* These lessons are continued from Vol. V. *Family Tutor*, and will be completed in the course of the present volume.

We shall divide the pronouns into six different classes: 1. Personal; 2. Possessive; 3. Relative; 4. Absolute; 5. Demonstrative; 6. Indefinite.

Of Personal Pronouns.—Personal pronouns are those which are used to designate persons and things. There are three persons; the first is that who speaks; the second is that who is spoken to; the third is that who is spoken of. Personal pronouns may be nominatives or objectives.

Of the Personal Pronouns, I, Thou, He, She, It, We, You, They, *used as Nominatives in sentences which are not Interrogative.*—When the pronouns *I, thou, he, she, it, we, you,* and *they,* are used simply as nominatives of the following verb, in sentences which are not interrogative, they are, in French as in English, placed before the verb, and expressed as follows:

Speaking of Person:—I speak, *je* parle; thou speakest, *tu* parles; he or she speaks, *il* or *elle* parle. We speak, *nous* parlons; you speak, *vouz* parlez; they speak, *ils* or *elles* parlent. Speaking of things:—It is interesting, *il* est intéressant, (speaking of a book); it is large enough, *elle* est assez grande, (speaking of a carriage); it rains, *il* pleut, (used impersonally); they are interesting, *ils* sont intéressants, (speaking of books); they are large enough, *elles* sont assez grandes, (speaking of carriages.)

Of Personal Pronouns used as Nominatives in Interrogative Sentences.—When a personal pronoun is used in an interrogative sentence, it is placed after the verb in simple tenses, after the auxiliary in compound tenses, and is separated from either by a hyphen; as in, Do I speak? parlè-*je?* Dost thou speak? parles-*tu?* Does he or she speak? parle-t-*il* or *elle?* Do we speak? parlons-*nous?* Do you speak? parlèz-*vous?* Do they speak? parlent-*ils* or *elles?* Is it interesting? est-*il* intéressant? (speaking of a book); Is it large enough? est-*elle* assez grande? (speaking of a carriage); Does it rain? pleut-*il?* (used impersonally).

Of several cases in which Personal Pronouns used as Nominatives are placed after the Verb, although the sentence is not Interrogative.—When the verb is in the subjunctive mood without a conjunction expressed before it; as, May I with my own eyes see the thunder fall!—Puissè-*je* de mes yeux voir tomber la foudre!

When the verb forms a proposition which shows that the words of some person are referred to; as, I shall be dissatisfied, said he, if you repeat my words.—Je serai mécontent, dit-*il,* si vous répétez mes paroles.

When the verb is preceded by any of the following adverbs:—Therefore, thus, aussi; Perhaps, peut-être; Still, encore; At least, for all that, &c., toujours; Vainly, en vain, vainement; At least, au moins, du moins. Therefore the king is very powerful, Aussi le roi est-*il* très puissant; Perhaps we shall go to-morrow into the country, Peut-être irons-*nous* demain à la campagne; Still it is true that you did behave badly, Encore est-*il* vrai que vous vous conduisîtes très mal; At least it is certain that he is a rogue, Toujours est-*il* certain que c'est un coquin; Vainly did he try to stop my horse, En vain, essaya-t-*il* d'arrêter mon cheval; At least it is certain that you have deceived me, Du moins, *or* au moins, est-*il* certain que vous m'avez trompé.

This exception is not absolute, for it would not be a fault against the language to place the pronoun before the verb; but then the locution would be flat, and deprived of grace and elegance.

Of Personal Pronouns used as Nominatives in sentences expressing a strong feeling of Wonder, Admiration, Indignation, &c.—Sentences expressing a strong feeling of wonder, admiration, indignation, or used emphatically, admit of several modes of construction, in which the personal nominative pronouns are not used in French as they are in English. If a man, for instance, being innocent of the charge, were suspected of intending to betray the interest of his friend, and should exclaim: I would betray the interest of my friend! No, never! This sentence, in order to convey the state of feeling of the speaker, should be rendered as follows:—*Moi,* trahir les intérêts de mes amis! Non, jamais! or, *Moi je* trahirais les intérêts de mes amis! Non jamais! or, *Je* trahirais les intérêts de mes amis, *moi!* Non, jamais!

The first sentence is elliptical; the words *Je pourrais, I should be such a man as,* are understood. The two others are merely emphatic, but have much force.

The pronouns of the other persons, singular and plural, should be *toi, lui, elle, nous, vous, ils, elles,* for *thou, he, she, we, you,* and *they;* as, *toi* trahir, or *tu* trahirais;

lui or *elle* trahir, or *il* or *elle* trahirait ; *nous* trahir, or *nous* trahirions ; *vous* trahir, or vous trahiriez ; *eux* or *elles* trahir, or *ils* or *elles* trahiraient.

In pronouncing the above sentences, a strong emphasis should be laid on the pronouns *moi, toi,* &c. If a man who attaches much importance to his own opinion should say, You maintain that these doctrines are correct, and I pretend they are false. This sentence, in order to convey the state of his mind, should be rendered by, Vous soutenez que ces doctrines sont vraies, et *moi, je* prétends qu'elles sont fausses. The omission of the pronoun *moi* would render the sentence flat and inexpressive.

Of the Personal Nominative Pronouns, I, Thou, He *&c., used after the Verb* To Be *in English, or preceding the Defective Verbs,* Will, Shall, Would, Could, *&c., or any other used in their stead, in answer to a question.*—Whenever the pronouns *I, thou, he,* &c., are used in English after the verb *to be,* they are considered in French as the attributes or objects of that verb, and expressed by the objective personal pronouns *moi, toi, lui, elle, nous, vous, eux,* or *elles;* as in, It is I who love you, and not he, C'est *moi* qui vous aime, et non pas *lui.* The second part of the sentence is elliptical, and signifies, *It is not he, Ce n'est pas lui.* It is thou who will do that, C'est *toi* qui feras cela ; It will be he or she who will go to town, Ce sera *lui* ou *elle* qui ira à la ville, &c.

Sometimes the verb *to be* is not expressed, as is the case in answering questions with the defective verbs *wilt, shall, could,* &c. ; but the pronouns *I, thou, he, her,* &c., should be expressed as in the preceding cases, and the words *will, shall,* &c., be suppressed, as in Who will do that ? I will. (For it will be I who will do it.) Qui fera cela ? Moi. Who has done that ? He has. (It is he who has done it.) Qui a fait cela? Lui, &c.

Of the Personal Nominative Pronouns followed by an Adjective.—When either of the personal pronouns *I, thou, he, she,* &c., is used before an adjective, it is still expressed in French by the corresponding objective pronouns *moi, toi, lui, elle,* &c. ; as in, I alone can do that, *Moi* seul peux faire cela; He, with six others, has raised this boat, *Lui* septième, a relevé ce bateau.

These sentences are elliptical, and signify, *It is I alone who,* &c., *It is he who with,* &c.; the pronouns *he, I,* &c., are therefore objective, and should be expressed as such.

Of the Personal Nominative Pronouns I, Thou, He, She, *&c., used in Distributive sentences.*—A sentence is called distributive, when a fact having been, or being about to be accomplished, that sentence expresses the part which each individual has taken or will take in it; in such cases, the nominative pronouns *I, thou, he, she,* &c., used as English, are still expressed in French by the objective pronouns *moi, toi, lui, elle,* &c., provided these pronouns are of different persons or genders; as in, Your two brothers and mine will take hold of this enterprise; *they* will furnish the money, and *he* will do the work, Vos deux frères et le mien se chargent de l'entreprise ; *eux* fourniront l'argent, et *lui* exécutera le travail. Your brother and sister were both present when I fell; he helped me to get up, and she laughed at the accident. Votre frère et votre sœur étaient présents quand je suis tombé ; *lui* m'a aidé à me relever, *elle* a ri de mon accident.

These sentences are still elliptical ; the verb *to be* is understood before the pronouns *I, he, she,* &c.; they are then, in fact, objective pronouns, and should assume the character in French.

Of the Personal Nominative Pronouns I, Thou, He, She, *&c., used in Exclamative Sentences, or in an Apostrophe.*—The personal pronouns *I, thou, he, she,* &c., used in English in exclamative sentences, or in an apostrophe, are expressed in French by the objective pronouns, *moi, toi, lui, elle,* &c.; as in, Thou whom I so dearly loved ! what has become of thee ? *Toi* que j'aimais si tendrement ! qu'es tu donc devenu? He who so often betrayed me, why do I still love him? *Lui* qui m'a si souvent trahie, pourquoi donc l'aimè-je encore?

Of the Personal Nominative Pronouns I, Thou, He, She, *&c., used after* than *and* as, *in a comparison of equality, inferiority, or superiority.*—When either of the personal pronouns *I, thou, he,* &c., is used after *than* or *as*, in a comparison of equality, superiority, or inferiority, it is expressed in French by one of the corresponding objective pronouns *moi, toi, lui, elle,* &c. ; as in, You are not so handsome as I, Vous n'êtes pas aussi belle que *moi*; Your brother is better than he or she, Votre frère est meilleur que *lui* or *elle;*

You are less rich than they, Vous êtes moins riches qu'*eux* or *elles*.

Of the Personal Nominative Pronouns I, Thou, He, *&c., followed by a Relative Pronoun.*—Whenever either of the personal pronouns *I, thou, he,* &c., is followed by a relative pronoun, which, being at the head of an incidental preposition, separates the nominative pronoun from the verb of which the pronoun is the subject, the pronouns *I, thou, he,* &c., are expressed in French by the objective pronouns *moi, toi, lui, elle,* &c., as in, He who is poor now, has commanded the armies of the republic, *Lui, qui* est si pauvre aujourdhui, a *or* il a commandé les armées de la république.

But when the relative pronoun comes after the personal pronoun of the third personal singular or plural, and does not stand at the head of an incidental sentence, so that no comma should be placed between the two pronouns, the English personal pronoun becomes demonstrative in French, as meaning *that person who,* and is expressed by one of the following words: Celui, he; Celle, she; Ceux, they (masculine); Celles, they (feminine); as, He who thinks himself happy, is always sure to be so, *Celui qui* se croit heureux, est toujours sûr de l'être; They are mistaken who think that happiness consists in riches, *Ceux qui* croient que le bonheur consiste dans les richesses, se trompent.

How the Personal Nominative Pronouns je, tu, il, *&c.,* I, thou, he, *&c., should be used in the construction of sentences, in order that no ambiguity should exist in reference to the noun to which these Pronouns relate.*—There can never be any ambiguity or doubt in regard to the noun which the personal pronouns of the first and second persons, singular or plural, represent; but it is not the same with those of the third person; the following rule must then be observed:—

The nominative pronouns *il, elle, ils, elles,* must always refer to a noun, either nominative or objective, employed definitely; but never to both, nor to a noun taken in an indefinite meaning; thus the following sentence is correct:—Nature, as a minister of the irrevocable decrees of God, never deviates from the laws which *it* has received from him; *it* does not alter in any way his plans, and in all *it* accomplishes, *it* shows the seal of the Almighty—Ministre des ordres irrévocables de Dieu, la nature ne s'écarte jamais des lois qu'*elle* a reçues de lui; *elle* n'altère en rien, les plans qui lui ont été tracés, et dans tout ce qu'*elle* accomplit, *elle* présente le sceau de L'Eternel; because the personal pronoun *elle* refers to *nature,* a nominative used in a definite manner. Slavery does not prevent the happiness of the slave, when he has not enjoyed the gift of liberty—L'esclavage n'empêche pas le bonheur de *l'esclave*, quand *il* n'a pas joui du bienfait de la liberté.

This sentence is correct, because *il* refers to *esclave,* which is used as the object of the noun *bonheur,* and is taken definitely.

But the following sentence, Racine has imitated Euripides in all that he has beautiful in his *Phedra*—*Racine* a imité *Euripide* dans tout ce qu'*il* a de plus beau dans sa Phèdre, is incorrect, because *il* is used after two nouns, one being nominative, the other objective, and may relate to either Racine or Euripides; the phrase then is ambiguous, and therefore incorrect.

This sentence also is incorrect: You have the right of chase, and I think it well founded, Vous avez *droit de chasse*, et je *le* trouve fondé, or, *il* est fondé selon moi, because in the first mode of translation, *le,* the objective personal pronoun, and in the second, *il,* the nominative personal pronoun, refer to *droit de chasse,* which is used indefinitely, not being preceded by an article. The following sentence is also incorrect: No peace for the wicked; he seeks it, it flies, Nulle paix pour le méchant; il *la* cherche, *elle* fuit; because *la,* the objective, and *elle,* the nominative pronouns, refer to *nulle paix,* when the meaning of the sentence requires that it should relate to *paix* in the affirmative.

This rule, which results from the necessity of clearness, so much required in the French language, is one of the most difficult in its application, and requires the constant attention of the writer.

In the impersonal verbs, *it, il,* does not seem to take the place of a noun, as in the following phrases: It rains, *Il* pleut; Many events have passed, *Il* s'est passé bien des évènements. But the first sentence is elliptical, and means, *le ciel* (*il*) *pleut,* and the second could be constructed in this way, *bien des évènements* (*il*) *se sont passés.*

Of several Personal Pronouns joined by the Conjunction And, Et, *and used together, as Nominatives of the following Verb.*—When, instead of one, there are several pronouns of different persons used as nominatives, they are expressed in French by the objective pronouns *moi, toi, lui, elle,* &c., and the following rules must be observed: The person who speaks is always mentioned the last, the person addressed is named first, and the verb is generally preceded by the personal nominative pronoun of the first person plural, *nous, we,* if there is a pronoun of the first person among those employed as nominatives; as, You and I will go hunting to-morrow, *Vous* et *moi, nous* irons demain à la chasse. If there is no pronoun of the first person among the nominatives, the verb is generally preceded by the nominative pronoun of the second person plural, *vous, you;* as, You and he will go hunting to-morrow, *Vous* et *lui, vous* irez demain à la chasse. If the two pronouns used as nominatives are both of the third person singular or plural, the verb is put in the third person plural, without being preceded by the personal plural pronoun of the third person; as, He and they will go hunting to-morrow, *Lui* et *eux iront* demain à la chasse. In the first and second of these three sentences, the verbs are preceded by the pronouns *nous* and *vous,* because those verbs having each two nominatives of different persons, usage has decided that the first person should be the noblest of the three and the second nobler than the third. We have said *generally,* in speaking of the use of the pronouns *nous* and *vous,* because some of our best writers have sometimes dispensed with them; but it is better to use them.

In the third sentence, the two nominative pronouns being of the same person, it is sufficient that the verb should be in the third person plural, to agree with both. If the pronouns of the three persons, singular or plural, should be employed as nominatives, the verb should be employed in the first person plural, and generally preceded by the personal pronouns of that person; as, He, you, and I, will go hunting to-morrow, *Lui, vous* et *moi, nous* irons demain à la chasse; or, *Nous* irons demain à la chasse, *lui, vous* et *moi.* But the order in which the pronouns are placed in regard to each other should never be altered. The same rule is applied when a noun is employed with one or more pronouns as nominatives of a verb; as in, My father and I will go to town this evening, *Mon père* et *moi, nous irons,* or simply, *irons,* ce soir à la ville; My sister and you are very pretty, *Ma sœur* et *vous, vous êtes,* or simply, *êtes,* très jolies; My mother, you, and I will set out to-night, *Ma mere, vous* et *moi, nous partirons,* or simply, *partirons,* cette nuit; My servant and he are at work in the fields, *Mon domestique* et *lui travaillent* dans les champs.

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INORGANIC CHEMISTRY.*

METALLIC ELEMENTS.

1. *General Properties of Metals.*

THE *number of the metallic elements* is about forty-two, or three times the number of the non-metallic bodies, which have already engaged our attention. If we include five lately proposed new metals, we shall have forty-seven bodies in this class. Of all this number, however, a few only are of considerable interest, while many (at least half) are totally unknown in common life. The minerals which contain several of the rare metals, in combination with various substances, are among the most uncommon specimens of mineralogical cabinets.

A *metal* is a body which conducts electricity and heat, which is opaque, and has a peculiar brilliancy, known as the metallic lustre. It has been before remarked that metallic lustre is the only property which belongs peculiarly and solely to this class of bodies. A metal, when submitted in solution to electrolysis, is always given out at the negative side of the battery, and is therefore a positive electric. Any body which possesses these general properties is a metal, according to our present notions of the metallic character. We see every variety in some of these characters. Some metals are almost without lustre, as manganese, while others, like gold and silver, may stand as examples of perfection in this as well as in all other metallic properties. Opacity is not complete even in gold and mercury, as already mentioned. Some metals are perfectly malleable when cold, as silver, gold, lead, and tin; others are malleable when hot, as iron, platinum, &c., and are not without this property, though in a less degree, even when cold. Some, like zinc, are laminable at a moderate heat, but brittle above and below it; others, like antimony, are brittle at all temperatures short of fusion. We have already explained the properties of brittleness, malleability, ductility, and laminability. The tenacity of metals depends much on their relations to these properties. Iron is an example of great tenacity and ductility, while in malleability it is much inferior to gold and silver.

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* As we have given part of "INORGANIC CHEMISTRY" in Vols. I. and II. of the FAMILY TUTOR, we have now commenced the continuation of the subject; so that our pupils who possess the former volumes of the work will, when "Chemistry" is finished, have one of the best complete modern works on the subject.—EDITOR.

The tenacity of metals is compared by using wires of the same size of different metals, and ascertaining how much weight they will sustain. Iron is the most tenacious, and lead, the least. Wires are drawn through smooth conical holes in a steel plate, each succeeding hole being a little less than its predecessor. In this way wires of extreme fineness may be drawn from several of the ductile metals. Dr. Wollaston succeeded, by a peculiar method, in making a gold wire so small that 530 feet of it weighed only one grain; it was only $\frac{1}{5000}$ of an inch in diameter; and a platinum wire was made by the same philosopher, of not more than $\frac{1}{30000}$ of an inch. Metals passed repeatedly through the rolling-mill, or wire plate, become stiff and brittle, but are again made soft by heating them to redness and cooling them slowly. This is called *annealing*. Copper is annealed by plunging the red-hot metal into cold water, while the same treatment renders iron and steel extremely hard.

The fusibility and density of metals differ very much. Platinum is at once the most dense of all bodies, being 21 to 21·5, and also one of the most infusible. Gold is next in density (19·26), but fuses at 2016° F. Palladium, uranium, cobalt, nickel, iron, molybdenum, manganese, columbium, tungsten, and titanium, are all infusible below 3000°, the heat of the most powerful air furnace; and most of these are altogether infusible. In density, sodium and potassium occupy the lowest points (·972 and ·865), being less in density than water, and they also fuse at the low temperature of 190° and 136°.

Metals vary also in volatility as much as in other properties. Mercury boils at 662°, and arsenic, tellurium, cadmium, zinc, potassium, and sodium, are also volatile at temperatures below a red heat. It is not impossible that all the metals would be volatile, if we could heat them highly enough; but many of them, as gold, platinum, silver, &c., may be exposed to the highest heat of a wind-furnace without change. Some metals assume a semi-fluid or pasty condition before melting, such as platinum and iron, both of which can be welded or made to unite without solder, when in this soft state; lead, potassium, and sodium can be welded in the cold, as also can mercury, when it is frozen. In cooling from fusion, some metals crystallize beautifully, of which bismuth is an example, while others, as gold and platina, are not commonly seen in the crystalline form.

The metals are rarely found in their metallic state in nature. Their characters are generally masked under some form of combination with oxygen or sulphur. Thus, iron is perhaps never seen in a malleable form in mines. The masses of malleable iron found on the surface of the earth are probably all of meteoric origin, having fallen through the atmosphere to the earth. Some metals, as gold, silver, platinum, copper, bismuth, and a few others, are frequently found native, or in the malleable form, either pure or alloyed with each other. An alloy is the union of two metals, as of copper and zinc, to form brass, and lead and tin, to make pewter, &c. Gold is usually found alloyed with silver, and platinum has generally several rare metals alloyed with it. Alloys are feeble chemical combinations, and are usually best suited to artificial purposes when made in the atomic proportions of the several metals. The alloys of mercury are called *amalgams*. Copper and tin unite in several distinct proportions, forming very unlike alloys, as gun and bell metal, and speculum metal. Several distinct compounds of gold and silver, and also of other metals, have been recognised.

In their chemical relations the metals are highly electro-positive, and form compounds with all the members of the oxygen group, and with phosphorus, carbon, &c. They all unite with oxygen, and usually in more than one proportion, but their affinity for this element is very various. The majority of metals will combine slowly with the oxygen of the air, forming a coating of oxide (or rust), which usually protects the metal from further action. This is the case with lead, zinc, copper, and iron. Sodium and potassium, and the metals of the alkalies generally, have so strong an affinity for oxygen as to be able even to decompose water at all temperatures.

The oxides of the metals may be divided into three classes. 1st, the protoxides, which are strongly basic; 2nd, neutral, or those which are neither basic nor acid; 3rd, those which are decidedly acid in their relations. The changes of character in oxides have a uniform relation to the amount of oxygen they contain, the higher oxides being either neutral or decidedly acid. Thus the protoxide of manganese is a strong base, the deutoxide is feebly basic, the peroxide is indifferent, and the higher oxides are the manganic and permanganic acids; which are capable of replacing sulphuric and hyperchloric acids. Arsenic and antimony have no protoxides, and are remarkable for forming strong acids with oxygen. By this feature they are closely assimilated, as has already been remarked, to the non-metallic bodies.

The compounds which the metals form with chlorine, iodine, sulphur, &c., bear a very striking analogy in composition to the oxides of the same metals. So true is this, that knowing what oxides a given metal forms, we can almost certainly tell what the composition of its sulphurets, chlorides, &c., will be. Thus the oxides of iron being FeO and FeO_2O_3, we find that the sulphurets of the same metal are FeS and Fe_2S_3, and the chlorides $FeCl$ and Fe_2Cl_3. It might be inferred from this statement, that where these metallic bodies unite with acids to form salts, there would be the tame conformity among them that is found among their bases, and such we shall find to be the fact.

Combinations of the metallic oxides, chlorides, sulphurets, &c., take place always among members of the same series, that is, oxides with oxides, chlorides with chlorides, sulphurets with sulphurets, and so on: those members of the same series which differ greatly in character being most disposed to unite, as the oxygen acids with the oxygen bases, &c. Thus, sulphuric acid (a powerful oxygen acid) and protoxide of iron (a powerful oxygen base) unite to form a salt which is entirely neutral, and in which the properties of neither constituent are sensible, having the formula FeO, SO_3 for the dry sulphate of iron.

Compounds which belong to unlike or different series, on the contrary, do not unite, but often mutually decompose each other. Thus, when hydrochloric acid and potash are brought together, both are decomposed, water and chloride of potassium being formed, as may be understood from the following symbols:

Potash.		Hydrochloric Acid.		Water.		Chloride of Potassium.
KO	$+$	HCl	$=$	HO	$+$	KCl

The latter remains in solution, and may be obtained in crystals on evaporation.

When any base unites with an acid to form a neutral salt, there must be as many equivalents of acid employed as there are of oxygen in the base itself. The same is true also of those acids which contain no oxygen, as the hydrochloric, provided the metallic oxide dissolves in hydrochloric acid without the evolution of chlorine. For example, peroxide of iron dissolved in hydrochloric acid produces water and a perchloride of iron: $3HCl$ and Fe_2O_3 giving rise to $3HO$ and Fe_2Cl_3.

Theory of Salts.—The binary compounds of chlorine, iodine, &c., with many of the metals, particularly those of the alkaline class, have in an eminent degree the properties of salts, and among them we recognise particularly the chloride of sodium or common salt, which is the parent, it may be said, of all salts; or that body from which they are all named. If the old definition of a salt, however, be admitted, those bodies cannot be called salts, since according to that view a salt is a compound of the *oxide of a metal* with an oxygen acid. To avoid this difficulty, two classes of salts have been instituted, the first of which includes all those binary compounds which, like common salt, have a metallic base in direct union with a *salt-radical;* and the second includes those salts which, like sulphate of soda, are supposed to be constituted of the oxide of the metal and an oxygen acid. The first have been called the *haloid** salts, and the second the *oxy-salts.*

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* From *als* (ἁλς), and *eidos* (εἶδος), in the form or likeness of.

The term "salt-radical," just employed, includes not only all the members of the oxygen group, except oxygen itself, but also all those *compound* bodies which, like cyanogen, and numerous similar substances, act the part of elements in the formation of compounds.

In stating the constitution of sulphuric acid, it will be remembered that the expression $SO_4 + H$ was employed as an equivalent to $SO_3 + HO$. It is claimed that all the hydrated acids are in reality compounds of hydrogen with a similar radical, and accordingly nitric acid will be NO_6+H, instead of NO_5+HO. One principal objection to this view is, that these hypothetical radicals have never been isolated. But the same is true of NO_5, which is entirely an unknown body, and so are nearly all the organic acids, independently of water or hydrogen. Moreover, those acids which are capable of existing dry and in a separate state, as sulphuric (SO_3), phosphoric (PO_5), and carbonic (CO_2), *are not acids* as long as they remain dry, and although they form compounds with dry ammonia, these compounds *are not salts.* Sir Humphrey Davy long ago proposed to consider hydrogen as the real acidifying principle in all acids. This view of the case is therefore by no means new. What we now know of the metallic character of hydrogen, goes to confirm his theory. If the salt-radical theory is to be adopted, all acids will be considered as hydrogen acids, and all salts as haloid salts. For example, let us take two common saline bodies and present them according to these two views.*

	Old view.	New view.
Sulphate of zinc,	$ZnO+SO_3$	$Zn+SO_4$
Nitrate of soda,	$NaO+NO_5$	$Na+NO_6$

According to the new view, when an acid dissolves a metal, there is no necessity for supposing water to be decomposed. The metal takes the place of the hydrogen, and the latter is given off in a gaseous form; or if the oxide of the metal is used, the oxygen and hydrogen unite to form water, and no effervescence ensues. We shall consider the saline compounds of the metals under each, and not devote a separate part of the work to their discussion. The nomenclature of the salts has already been explained, and need not be repeated here.

2. *Classification of Metals.*

Until we are more familiar than we now are with all the principles of isomorphism, with the constitution of many metallic oxides, sulphurets, &c., and the relations with which the study of organic chemistry is constantly unfolding, it will not be found easy to name an unexceptionable classification for the metallic bodies. The order in which the metals are discussed in the following pages does not differ materially from that generally followed in elementary works, and it is presumed that it will be found well adapted to the purposes of the general student.

CLASS I. METALS OF THE ALKALIES.—

XV. POTASSIUM.

Equivalent, 39·19. *Symbol,* K. (*Kalium.*)
Density, ·865.

History.—Potassium was discovered by Sir Humphrey Davy in 1807; at the same time with its congeners, sodium, barium, strontium, and calcium. Before that time the alkalies and alkaline earths were looked upon as simple elementary bodies, and were so treated in all chemical works. Davy found that on passing the electric current from a powerful voltaic battery, through a cake of moistened potash, both electrodes being of platinum, violent action followed, oxygen was evolved with effervescence at the positive pole, and bright metallic globules, like mercury, accompanied by hydrogen gas, appeared at the negative pole. Some of these globules flashed and burnt with a violent light as they reached the air, and others remained and were soon covered with a white film that formed on their surfaces. These globules were the metal potassium, and its discovery constitutes one of the most interesting chapters in chemical history.

Potassium in combination, chiefly as silicate of potash, is widely diffused over the globe. It forms a part of all fertile soils, and the chief source from which it is artificially procured is the ashes of hard-wooded forest-trees, which derive it from the soil on which they grow. It is also present in sea-water, as the chloride of potassium, and is found in the ashes of sea-plants.

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* It is impossible to do justice to the new theory of salts in so limited a space as we allot ourselves, and the reader who wishes to seek further information is referred to Mr. Graham's "Elements of Chemistry," p. 158. This view has been strongly controverted, and is frequently rejected. In America it has been contested by Dr. Hare. —See "Ann. Jour. Sciences," vol. i., 2nd series, p. 82, 377.

Preparation.—The expensive and troublesome method of procuring this metal by galvanism has been replaced by a much more convenient and productive furnace operation, founded on the decomposition of potash at a white hoat by charcoal. For this purpose carbonate of potash is intimately mixed with charcoal, which is best prepared by igniting cream of tartar in a covered crucible, which yields a black mass commonly known as *black flux*, consisting of carbonate of potassa, and charcoal derived from the orgaic acid. This mass is finely powdered, and one-tenth part of charcoal in small lumps being added to it, the whole is transferred to an iron retort, formed of a quicksilver bottle, and laid horizontally in a powerful wind-furnace. A short iron tube connects the iron bottle with a copper vessel of peculiar construction, containing naphtha, and kept cold. The bottle is then gradually raised to an intense heat, having been previously protected by a well-dried coating of sand-luting to guard the iron against fusion. Decomposition of the carbonate of potash follows, carbonic oxide gas escapes, and metallic potassium distils over in melted globules, which fall into the naphtha, where they are preserved. Many precautions are required to insure success, and particularly to see that the tube of delivery does not become stopped; to guard against which, the apparatus is so constructed that a strong iron rod can be thrust in to clear the opening.

The first product is not pure, and must be redistilled in a small iron retort, with a little naphtha, into a receiver containing that liquid. It is requisite to employ naphtha in this process, because it contains no oxygen in its constitution, and does not readily suffer change from the action of potassium.

Properties.—Potassium, when recently obtained, is a brilliant, silver-white metal, possessing the metallic lustre in an eminent degree. At common temperatures it is soft like putty, and may be easily moulded or welded by the fingers. It is the lightest metal known, having a density of only ·865; consequently it floats on water, for the oxygen of which it has so great an affinity as to decompose it at all temperatures. It burns brilliantly on the surface of the water with a beautiful violet-purple flame, and is rapidly propelled over its surface by the gases and vapours evolved in the combustion, forming one of the most attractive of chemical experiments. The hydrogen of the decomposed water also burns at the same time. Any considerable quantity thrown on water will explode violently, scattering the burning metal in all directions. Exposed to the dry air, it soon tarnishes, and gradually falls to a white powder (potash). Its metallic lustre may be beautifully seen by melting it under naphtha, when it is extremely brilliant. At 30° it is brittle and crystallizes in cubes; at 150° it melts, and below redness it boils and is raised in vapour. It may be distilled unchanged, in vessels free from oxygen.

The uses of potassium are purely scientific. It is a most powerful means of research, since its affinity for oxygen is so great as to enable it to decompose the chlorides of aluminium, glucinum, yttrium, thorium, magnesium, and zirconium, yielding to us the metallic bases of these compounds. It is also, as will be remembered, the means by which silicon and boron are obtained.

1. *Compounds of Potassium.*

Potassium combines with all the members of the first three classes, forming bodies, several of which are of great importance in the arts and in pharmacy. We can describe only a few of the most important of these compounds.

The oxide of potassium is formed only when potassium is exposed to dry oxygen or common air. It is a white powder, strongly alkaline, which has a great affinity for water, forming with it three distinct hydrates, the first of which is *caustic potash.* (KO,HO.) This hydrate is a white solid, which fuses at a temperature near to redness; but no degree of heat will expel the equivalent of water with which it is combined. On cooling, it forms a somewhat crystalline, compact mass, which has a great avidity for water, attracting it rapidly from the atmosphere. Half its weight of water will dissolve it, and it is also soluble in alcohol. It is best prepared by decomposing pure carbonate of potash, dissolved in ten parts of water in a clean iron vessel, with half its weight of good quick-lime, previously slaked and mingled with so much water as to form a thin paste, called milk of lime. This is added in small portions to the potash solution while the latter is boiling, a short interval being allowed between each addition; all the lime being added, the whole is boiled for a few minutes, and then is removed from the fire and covered up. Care is needed to keep the solution dilute, to prevent the caustic potash formed from decomposing the resulting carbonate of lime. After standing a few hours, until all the lime has settled and the liquid is clear, it is drawn off by a syphon, and concentrated by boiling in a clean iron pan or silver capsule, until it has an oily consistence, when it is poured out upon a clean surface of iron or marble; it then hardens into the white solid hydrate called caustic potash. To insure its purity, it may be dissolved in absolute alcohol, which will leave behind its impurities. The alcohol is expelled from the decanted solution by heat, and the solid potash recovered by fusion in a silver crucible. The moderately strong solution of potash answers most of the purposes of the laboratory as well as the solid hydrate.

The solution of caustic potash is intensely alkaline, saturates the most powerful acids, restores the colours of reddened vegetable blues, and turns many of them green; it has an acrid and most disgusting taste, peculiar to alkalies, and, when strong, attacks all organic matters, dissolving and disorganizing them. Its solution feels soapy on the fingers, and forms compounds with fats, called soaps. The solid potash is often used as a caustic by surgeons, whence its name. Silica is dissolved by it. Its solution absorbs carbonic acid perfectly, and is employed for that purpose in organic analysis; the solid potash removes both carbonic acid and moisture from the air, and is therefore sometimes used in desiccation.

The presence of potash in solution may be detected by an alcoholic solution of the chloride of platinum, which throws down a yellow crystalline precipitate in a concentrated solution. Perchloric, tartaric, and hydrofluosilicic acids, are also tests of the presence of potash, which forms with all of them precipitates but little soluble in water.

Peroxide of Potassium is an orange-yellow powder, formed by passing oxygen over potash heated to redness in a tube. It is decomposed by water, oxygen being given off, and a solution of potash remaining.

Chloride of Potassium may be formed by the direct combustion of potassium in chlorine gas, which takes place spontaneously. It is also formed by dissolving potash in dilute hydrochloric acid to saturation, when cubic crystals of chloride of potassium are obtained on evaporating the solution. It is also left as a residuum after the oxygen process. It has a bitter saline taste, and does not preserve meats, like the chloride of sodium.

Bromide of Potassium is prepared by saturating a solution of potash with bromide, evaporating the solution and igniting the residuum in a covered crucible of platinum or iron. The melted mass is bromide of potassium, and may be turned out to cool on an iron plate. In the solution, both bromate of potash and bromide of potassium exist, but the ignition expels oxygen, and only the bromide is left. It is a white soluble salt, which crystallizes in cubes, and is soluble in alcohol. The crystals are anhydrous, and decrepitate when heated, like common salt. Bromide of potassium is frequently found in the waters of saline springs and inland seas.

Iodide of Potassium, formerly called *hydriodate of potash,* is a compound of great use in medicine, being the form in which iodine is usually employed in medical practice. It is obtained by a process similar to that just described for the bromide, and also by decomposing the iodide of iron, by a solution of potash. It is a white salt in cubic crystals, very soluble in both alcohol and water. Its solution dissolves a large quantity of free iodine, acquiring thus a deep brown colour.

Fluoride of Potassium is obtained by the action of hydrofluoric acid on potash. It is perfectly analogous to the preceding salts, crystallizes in cubes, and is very soluble in water.

Sulphuret of Potassium.—Sulphur combines with potassium in several proportions

—probably in seven. The protosulphuret of potassium is made by melting together its constituents, or, better, by passing hydrogen gas over the neutral sulphate of potash heated to redness. Water is formed, and sulphuret of potassium remains. It is a bright red solid, and forms a colourless solution in water, which has an alkaline reaction. This is a sulphur base of considerable power, and combines with sulphur acids without decomposition. Other acids decompose it with the escape of sulphureted hydrogen. The *tritosulphuret of potassium* (KS_3) corresponds to the teroxide of the same base.

The Pentasulphuret of Potassium (*persulphuret* KS_5) is formed when sulphur is fused with carbonate of potash at as low a heat as possible; hyposulphate of potash is formed at the same time. The persulphuret is a deep orange-yellow solid, soluble in alcohol.

The protosulphuret is converted into the persulphuret by boiling in water with four equivalents of sulphur.

The Seleniurets of Potassium are supposed to be like the sulphurets, but are not much known.

Nitrogen forms a compound with potassium (K_3N).—When potassium is heated in dry ammonia, an olive-green solid is formed, which has the composition expressed by K,NH_2. When this is heated, ammonia escapes, and a gray body resembling graphite is left behind, which is the compound in question. *Phosphorus* also forms a solid compound with potassium—the phosphuret of potassium—which is decomposed by water with the escape of spontaneously inflammable phosphureted hydrogen.

Unimportant compounds are also formed by potassium with carbon and hydrogen; but no compound is known between it and silicon and boron.

2. *Salts of Potash.*

The salts of potash are numerous and important. We shall, however, mention now only the carbonates, sulphates, nitrate, and chlorate. As it will be altogether impossible to give even the names of all the salts of the metals, we must content ourselves with a selection of the most important and interesting.

Carbonate of Potash, $KO,CO_2 + HO$ (79·19).—This salt, in an impure form, is made on a great scale in America, under the name of *pearlash* and *potash,* which is the alkali obtained from the ashes of forest trees by lixiviation and combustion.

The crude article of commerce is contaminated by silica, sulphate of potash, and chlorides of potassium and sodium. The latter impurity is frequently added in the process of manufacture, either through ignorance, or from fraudulent motives. The best potash is made by using hot water to lixiviate the ashes, in small leach-tubs. The brown mass left by evaporating the lixivium to dryness in iron kettles, is the *potash* of commerce. This is moderately calcined to burn off the colouring matter, when a spongy mass of a fine light blue colour is left, which is the *pearlash.*

The pure carbonate is best obtained by calcining the cream of tartar (acid tartrate of potash), and dissolving out the carbonate from the coaly mass by water. The filtered solution is evaporated to dryness in a silver capsule, and the salt obtained pure.

The carbonate of potash has a strong alkaline taste, turns cabbage or dahlia paper green, and is somewhat caustic; it dissolves in about twice its weight of water, forming a solution, which is much used in the laboratory. It crystallizes with difficulty, and takes up two equivalents of water in so doing. It is quite insoluble in alcohol. This is a very deliquescent salt, and must be kept in well-stopped bottles.

Even when most pure it is apt to contain a trace of silica, from which it can be freed by igniting the bicarbonate, and evaporating its solution to dryness.

Several samples of American potash examined by Dr. L. C. Beck yielded 73·6; 74·6; 75 and 76·9 per cent. of carbonate and hydrate of potash; from 6 to 15 per cent. of chlorides of potassium and sodium; with from 1 to 15 per cent. of insoluble matter.

Bicarbonate of Potash ($KO, CO_2 + HO CO_2$), Equiv. 100·19.—This salt is formed by passing a stream of carbonic acid gas through a cold solution of carbonate of potash. It crystallizes in large and beautiful crystals referable to the right rhombic system. Four parts of water dissolve it; the solution has an alkaline taste and reaction, but is not caustic; by heat it is converted to the simple carbonate, and it loses a portion of carbonic acid by solution in hot water.

DISTRIBUTION OF ANIMALS.

BIRDS.

THE highest department of the animal kingdom, writes the Rev. W. Milner, commences with the class of *Birds*, which may be naturally divided into the three great orders of aërial, terrestrial, and aquatic. Aggregation into immense flocks is a distinguishing feature of several species, especially of the aquatic order, which form separate colonies, building their nests in the same site, though other spots equally adapted are at no great distance. Hence the Vogel-bergs, or bird-rocks of the northern seas, one of which at Westmannsharn in the Faroe group of islands, seldom intruded upon by man, presents a most extraordinary spectacle to the visitor. The Vogel-berg lies in a frightful chasm in the precipitous shores of the island, which rise to the height of a thousand feet, only accessible from the sea by a narrow passage. Here congregate a host of birds. Thousands of guillemots and auks swim in groups around the boat which conveys man to their domain, look curiously at him, and vanish beneath the water to rise in his immediate neighbourhood. The black guillemot comes close to the very oars. The seal stretches his head above the waves, not comprehending what has disturbed the repose of his asylum, while the rapacious skua pursues the puffin and gull. High in the air the birds seem like bees clustering about the rocks, whilst lower they fly past so close that they might be knocked down with a stick. But not less strange is the domicile of this colony. On some low rocks scarcely projecting above the water sit the glossy cormorants, turning their long necks on every side. Next are the skua gulls, regarded with an anxious eye by the kittiwakes above. Nest follows nest in crowded rows along the whole breadth of the rock, and nothing is visible but the heads of the mothers and the white rocks between. A little higher on the narrow shelves sit the guillemots and auks, arranged as on parade, with their white breasts to the sea, and so close that a hailstone could not pass between them. The puffins take the highest station, and, though scarcely visible, betray themselves by their flying backwards and forwards. The noise of such a multitude of birds is confounding, and in vain a person asks a question of his nearest neighbour. The harsh tones of the kittiwake are heard above the whole, the intervals being filled with the monotonous note of the auk, and the softer voice of the guillemot. When Graba, from whose travels this description is principally drawn, visited the Vogel-berg, he was tempted by the sight of a crested cormorant to fire a gun, but what became of it, he remarks, it was impossible to ascertain. The air was darkened by the birds roused from their repose. Thousands hastened out of the chasm with a frightful noise, and spread themselves in troops over the ocean. The puffins came wandering from their holes, and regarded the universal confusion with comic gestures. The kittiwakes remained composedly in their nests, whilst the cormorants tumbled headlong into the sea. Similar great congregations of the feathered race appear where the shores are rocky, high, and precipitous, but this is strikingly the case, where

> —"The northern ocean, in vast whirls,
> Boils round the naked melancholy isles
> Of farthest Thule; and the Atlantic surge
> Pours in among the stormy Hebrides.
> Who can recount what transmigrations there
> Are annual made? what nations come and go?
> And how the living clouds on clouds arise?
> Infinite wings! till all the plume-dark air
> And rude resounding shore are one wild cry."

Most terrestrial birds, unacquainted with man, exhibit a remarkable tameness, and are slow in acquiring a dread of him, even after repeated lessons that danger is to be apprehended from his neighbourhood. Mr. Darwin speaks of a gun as almost superfluous in the unfrequented districts of South America, for with its muzzle he pushed a hawk off the branch of a tree. Once, while lying down, a mocking thrush alighted on the edge of a pitcher, made of the shell of a tortoise, which he was holding in his hand, and began very leisurely to sip the water, even allowing him to handle it while seated on the vessel. In Charles Island, which had been colonised about six years, he saw a boy sitting by a well with a switch in his hand, with which he killed the doves and finches as they came to drink; and for some time he had been constantly in the habit of waiting by the well for the same purpose, to provide himself with his dinners. In the Falkland Islands, at Bourbon, and at Tristan d'Acunha, the same tameness was noticed by the early visitors. On the other hand, the small birds in the arctic regions of America, which have never been persecuted, exhibit the anomalous fact of great wildness. From a review of various facts, Mr. Darwin concludes, "first, that the wildness of birds with regard to man is a particular instinct directed against him, and not dependent on any general degree of caution arising from other sources of danger; secondly, that it is not acquired by individual birds in a short time, even when much persecuted; but that in the course of successive generations it becomes hereditary. Comparatively few young birds in any one year have been injured by man in England, yet almost all, even nestlings, are afraid of him; many individuals, however, both at the Galapagos and at the Falklands, have been pursued and injured by man, but yet have not earned a salutary dread of him."

Numerous species of birds may be regarded as the favourites of nature, on account of the gracefulness given to their shape, and the richly-coloured plumage with which they are adorned, as evidenced in the gaudy liveries of many of the parrot tribe, and the form and hues of the birds of paradise. But they are especially interesting to man for the faculty of song with which they are endowed; in some, "most musical, most melancholy," in others, sprightly and animating, inspiriting the sons of toil under the burdens peculiar to their station. It deserves to be remarked, as an instance of compensation and adjustment, that while the birds of the temperate zone are far inferior to those of tropical climes in point of beauty, they have far more melodious notes in connection with their less attractive appearance. The following catalogue of our singing birds contains the time of their beginning and ceasing to sing, from a mean of the observations of several years, with the numerical value of their notes, twenty being that of absolute perfection. For the catalogue we are indebted to Mr. John Blackwell and the Honourable Daines Barrington:—

Name.	Begins.	Ends.	Mellowness.	Sprightliness.	Plaintiveness.	Compass.	Execution.
Redbreast	Jan. 3	Dec. 14	9	8	12	14	14
Wren	13	3	1	16	0	2	5
Missel Thrush	Feb. 1	May 23	3	4	1	5	3
Throstle	8	Aug. 12	3	10	2	10	4
Skylark	9	July 8	4	19	4	18	18
Hedge Warbler	9	19	3	4	3	4	4
Chaffinch	10	7	2	14	1	4	5
Starling	15	May 30	4	2	2	4	2
Blackbird	Mar. 20	July 13	8	1	4	5	3
Green Grosbeak	24	Aug. 12	5	3	5	5	5
Titlark	Apr. 4	July 9	3	2	2	2	2
Lesser Redpole	5	Aug. 5	1	4	0	3	3
Woodlark	—	Oct. 25	18	2	17	8	6
Goldfinch	11	June	4	16	4	10	12
Redstart	14	29	1	4	0	2	2
Willow Wren	14	Aug. 23	6	4	5	5	5
Linnet	15	July 6	10	15	6	12	19
Lesser Field Lark	17	8	8	7	5	4	5
Swallow	19	Sept. 25	4	6	2	3	3
Stonechat	24	June	1	3	0	3	2
Whinchat	25	July 1	1	3	0	2	2
Blackcap	25	22	14	19	12	10	8
Whitethroat	29	16	1	4	0	3	3
Setty-chap	May 12	11	14	6	14	10	9
Sedge Wabier	17	16	2	16	0	18	14
Nightingale	—	—	19	14	19	19	19

From the powerful means of locomotion possessed by several of the bird tribe, and their great specific levity, air being admitted to the whole organisation as water to a sponge, it might be inferred, that the entire atmosphere was intended to be their domain, so that no species would be limited to a particular region. The common crow flies at the rate of twenty-five miles an hour; the rapidity of the eider-duck, *Anas mollissima*, is equal to ninety miles an hour; while the swifts and hawks travel at the astonishing speed of a hundred and fifty miles in the same time. It is true that some species have a very extensive range, as the nightingale, the common wild goose, and several of the vulture tribe. The same kind of osprey or fishing-eagle that wanders along the Scottish shores appears upon those of the south of Europe, and of New Holland. The lammergeyer haunts the heights of the Pyrenees, the mountains of Abyssinia, and the Mongolian steppes; and the penguin falcon occurs in Greenland, Europe, America, and Australia. In general, however, like plants and terrestrial quadrupeds, the birds are subject to geographical laws, definite limits circumscribing particular groups. The common grouse of our own country affords a striking exemplification of this arrangement, as it is nowhere met with out of Great Britain; and other examples occur of a very scanty area containing a species not to be found in any other region. The celebrated birds of paradise are exclusively confined to a small part of the torrid zone, embracing New Guinea and the contiguous islands; and the beautiful Lories are inhabitants of the same districts, being quite unknown in the New World. Parroquets are chiefly occupants of a zone extending a few degrees beyond each tropic, but the American group is quite distinct from the African, and neither of these have one in common with the parrots of India. The great eagle is limited to the highest summits of the Alps; and the condor, which soars above the peak of the loftiest of the Andes, never quits that chain. Humming-birds are entirely limited to the western hemisphere, where a particular species is sometimes bounded by the range of an island, while others are more extensively spread, the *Trochilus flammifrons*, common to Lima, being observed by Captain King upon the coasts of the Straits of Magellan, in the depth of winter, sucking the flowers of a large fuchsia, then in bloom in the midst of a shower of snow. Among the birds incapable of flight, which rival the quadrupeds in their size, the intertropical countries of the globe have their distinct species, presenting similar general features of organisation, as the ostrich of Africa and Arabia, the cassowary of Java and Australia, and the touyou of Brazil. In the arctic regions, we meet with species peculiar to them, the *Strix laeponicus* or Lapland owl, and the eider-duck, an inhabitant of the shores, from whose nests the eider-down is obtained. Several families of maritime birds are likewise limited to particular oceanic localities. Approaching the fortieth parallel of latitude, the albatross is seen flitting along the surface of the waves, and soon afterwards, the frigate and other tropical birds appear, which never wander far beyond the limits of the torrid zone. It thus appears, that, notwithstanding the great locomotive powers of birds, particular groups have had certain regions assigned to them as their sphere of existence, which they are adapted to occupy, and to which they adhere in the main, though it is easy to conceive of natural causes occasionally constraining to a migration into new and even distant territories. Captain Smyth informed Mr. Lyell, that when engaged in his survey of the Mediterranean, he encountered a gale in the Gulf of Lyons, at the distance of between twenty and thirty leagues from the coast of France, which bore along many land-birds of various species, some of which alighted on the ship, while others were thrown with violence against the sails. In this manner, many an islet in the deep, after ages of solitude and silence, uninterrupted except by the wave's wild dash, and the wind's fierce howl, may have received the song of birds, forced by the tempest from their home, and compelled to seek a new one under its direction.

There is no feature more remarkable in the economy of birds than the periodical migrations, so systematically conducted, in which five-sixths of the whole feathered population engage. In the case of North America, according to an estimate by Dr. Richardson, the passenger-pigeons form themselves into vast flocks for the journey, one of which has been calculated to include 2,230,000,000 individuals. We are familiar with the cuckoo as our visitor in spring, and with the house-swallow as our guest through the summer, the latter usually departing in October to the warmer regions of the south, wintering in Africa, returning again when a more genial season revives its insect food. By cutting off two claws from the feet of a certain number of swallows, Dr. Jenner ascertained the fact of the same individuals re-appearing in their old haunts in the following year, and one was met with even after the lapse of seven years. The arctic birds migrate farther south, when the seas, lakes, and rivers become covered with unbroken sheets of ice; the swans, geese, ducks, divers, and coots flying off in regular phalanxes to regions where a less rigorous winter allows of access to the means of life. Hence, soon after we lose the swallows, we gain the snipes and other waders, which have fled from the hard frozen north to our partially frozen morasses, where their ordinary nutriment may still be obtained. The equinoctial zone, where the seasonal change is that of humidity and drought, furnishes an example of the same phenomenon. As soon as the Orinoco is swollen by the rains, overflows its banks, and inundates the country on either side, an innumerable quantity of aquatics leave its course for the West India islands on the north, and the valley of the Amazon on the south, the increased depth of the river, and the flooded state of the shores, depriving them of the usual supply of fish and insects. Upon the stream decreasing, and retiring within its bed, the birds return.

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PRACTICAL ESSAYS ON EDUCATION.

DUTIES OF THE TEACHER.

The method which the writer proposes to follow in introducing to the readers of the *Family Tutor* the various topics which must necessarily be brought under notice in treating on Practical Education, is that which has appeared to him, after careful study, to be most natural; and, on the whole, best adapted to furnish a clear and condensed view of the entire subject. In these articles will be found, he ventures to hope, many remarks of the highest value; sometimes they will be the suggestions and advices of experienced teachers either in this country, in France, in Germany, or in the United States of America;* at other times, they will arise from his own experience of more than twenty years, as principal of a private school, averaging from fifty to sixty pupils. Little pretension will be made, however, to originality: the sole object of the writer will be to produce a series of papers of practical utility to all those engaged in the arduous but honourable career of teachers of youth.

In a school, whether large or small, one of the chief requisites is the determination to rule; but this, of course, is not all that is necessary. Children are to a greater extent than is usually supposed reasonable and intelligent beings; they are nearly as much influenced by motives as adults: and they should be governed much in the same way. Now, if a teacher, disregarding, or ignorant of this truth, insists upon ruling, simply by the exercise of physical force, he must expect to reap the due reward of his folly in the uneasiness, vexation, and perplexity which such a course will inevitably bring upon him.

Nor is this all. By doing so, he at once chokes up the spring of some of the highest enjoyments of which the human mind is susceptible. All men love power, especially moral power. Its exercise is universally grateful; the intensity of the enjoyment depending upon the number of minds which can be influenced; the perfection or dominant character of the influence itself; the difficulties which have been surmounted; the skill that has been exercised; and the amount of mind which has been brought to bear in its attainment. "It is this," says Mr. Abbott, "which gives interest to the plans and operations of human governments. Men can do but little by actual force. Much of the power that is held even by the most despotic executive, must be based on an adroit management of the principles of human nature, so as to lead men voluntarily to co-operate with the ruler in his plans."

Now, this particular kind of gratification—to use the opinion of Mr. Dunn—the able teacher enjoys in perfection. His school is the field of his enterprise; in proportion to his skill and ingenuity in managing human nature, is the measure of his success; and in that success he finds a rich reward. To lead, by the power of his own mind, many other minds in willing captivity—to turn the very waywardness and restlessness of childhood to the accomplishment of his own matured plans and purposes,—and to do this, without crushing the buoyancy of one spirit, or checking the flow of natural gladness in any one heart, is a triumph and a joy, abundantly compensating the toil and care by which it has been effected.

"Kindness in words and looks," says Dr.

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* The writer intends to furnish a list of the authorities he has consulted in the preparation of the Essays.

Knox, "effects wonders in children, who are governed more by what they feel and see, than by reason." And, in another part of his work on *Liberal Education,* he asserts that "extreme rigour is not only to be reprobated for its cruelty, but likewise for its inutility in promoting the purposes of education, and its ill effects on the puerile disposition. The heart is injured by it in a degree not to be compensated by any improvement of the understanding, even if it were found to contribute to improvement."

Dr. Arnold, at Rugby, kept corporal punishment as much as possible in the background, and by kindness and encouragement attracted the good and noble feelings of those with whom he had to deal. But among the younger part of the school he maintained that it could not without danger be abandoned. "The beau ideal," says he, "of school discipline with regard to young boys, would seem to be this, that, whilst corporal punishment was retained on principle, as fitly answering to and marking the naturally inferior state of boyhood, and therefore as conveying no peculiar degradation to persons in such a state, we should cherish and encourage to the utmost all attempts made by the several boys, as individuals, to escape from the natural punishment of their age, by rising above its naturally low tone of principle." Flogging, therefore, for the younger part, he retained; but it was confined to moral offences, such as lying, habitual idleness, &c.; while his aversion to inflicting it rendered it still less frequent in practice than it would have been according to the rule he had laid down for it. But in answer to the argument used in a liberal journal, that it was even for these offences and for this age degrading, he replied with characteristic emphasis:—

"I know well of what feeling this is the expression; it originates in that proud notion of personal independence which is neither reasonable nor Christian—but essentially barbarian. . . . . At an age when it is almost impossible to find a true manly sense of the degradation of guilt or faults, where is the wisdom of encouraging a fantastic sense of the degradation of personal correction? What can be more false, or more adverse to the simplicity, sobriety, and humbleness of mind, which are the best ornament of youth, and the best promise of a noble manhood?"

The infliction of punishment requires great judgment, and great command of temper; judgment to proportion the degree of severity to the degree of mental feeling, or want of it; and command of temper, that the cool results of the dictates of justice may not appear the effect of anger and revenge. "One must not be bitter in correcting," says Quintillian; "some reprimand, as if they hated the boy."

Not to be able to command passion, is to set a bad example to your scholars, and to lessen authority by showing weakness; for it is, undoubtedly, great weakness in an instructor to be carried away by the impulse of anger. Persons with such infirmity of temper should remember the saying of Seneca: "I would punish you as you deserve," observed that philosopher to his slave, "if I were not in a passion." And Archytas, returning from war, found his farm much neglected by his steward. "I would make you repent it," he said to the culprit, "if I were not exceedingly angry."

That was a saying, worthy of all acceptation, of Dr. Dwight, "He that makes a little child happier for half-an-hour, is a co-worker with God." It admirably expresses, in few words, the spirit which pervades the bosom of a teacher thoroughly adapted for his situation. Such a man loves his work because he delights in the exercise of the benevolent affections. His school-room is the theatre of his good-will; the place where his best feelings are developed and exercised.

Some of my readers may, perhaps, remember that part in Roger Ascham's *Schoolmaster,* in which he depicts the character of Mr. Elmer, preceptor to Lady Jane Grey, and the effect which his amiability had upon her.

"And one example, whether love or fear doth work more in a child, for virtue and learning, I will gladly report, which may be heard with some pleasure, and followed with more profit. Before I went into Germany, I came to Brodegate, in Leicestershire, to take my leave of that noble Lady Jane Grey, to whom I was exceedingly much beholden. Her parents, the Duke and the Duchess, with all the household, gentlemen and gentlewomen, were hunting in the park; I found her in her chamber, reading *Phœdon Platonis,* in Greek, and that with as much delight as some gentlemen would read a merry tale in Boccace. After salutation, and duty done, with some other talk, I asked her why she would lose such pastime in the park: smiling, she answered me—

"'I wis, all their sport in the park is but a shadow of the pleasure that I find in Plato; alas, good folk, they never felt what true pleasure meant.'

"'And how came you, madam,' quoth I, 'to this deep knowledge of pleasure, and what did chiefly allure you into it, seeing not many women, but very few men, have attained thereunto?'

"'I will tell you,' quoth she, 'and tell you a truth, which perchance ye will marvel at. One of the greatest benefits that ever God gave me is, that he sent me so sharp and severe parents, and so gentle a schoolmaster. For when I am in presence either of father or mother, whether I speak, keep silence, sit, stand, or go; eat, drink, be merry or sad; be sewing, playing, dancing, or doing any thing else, I must do it, as it were, in such weight, measure, and number, even so perfectly as God made the world, or else I am so sharply taunted, so cruelly threatened; yea, presently sometimes, with pinches, nips, and bobs, and other ways which I will not name, for the honour I bear them, so without measure misordered, that I think myself in hell, till time come that I must go to Mr. Elmer, who teacheth me, so gently, so pleasantly, with such fair allurements to learning, that I think all the time nothing whiles I am with him. And when I am called from him, I fall on weeping, because, whatsoever I do else, but learning, is full of grief, trouble, fear, and whole misliking unto me. And thus my book hath been so much my pleasure, and bringeth daily to me more pleasure and more, that in respect of it, all other pleasures, in very deed, be but trifles and troubles unto me.'

"I remember this talk gladly, both because it is so worthy of memory, and because also it was the last talk that ever I had, and the last time that ever I saw that noble and worthy lady."

As materially affecting the degree of comfort which a teacher will enjoy in his school, is the qualification—ability to interest children; not only to make them happy, but happy in the performance of their duty. This is a capability which, to a large extent, depends on the art of communicating instruction.

There is another qualification essential in a teacher; he must be in the possession, not merely of just sufficient knowledge to conduct his school, but of such an acquaintance with the elements of those branches which he has to teach, as shall give him the mastery of all their parts, and confidence in the correctness of his instructions. No one can clearly and simply explain to a child any thing with which he is not himself well acquainted.

Still, in order to be successful as a teacher, it is not necessary to be proficient in every thing, nor is it either wise or honest to make any such pretensions. A teacher brings an immense amount of unnecessary anxiety and irritation upon himself when he is ashamed to confess ignorance.

"I remember well," says Professor Jardine, "the striking effect produced on the minds of the students, by an instance of candour on the part of the late Dr. Reid, when he was Professor of Moral Philosophy in Glasgow University. During the hour of examination, they were reading to him a portion of *Cicero de Finibus;* when at one of those mutilated and involved passages which occasionally occur in that work, the student who was reading stopped, and was unable to proceed. The doctor attempted to explain the difficulty; but the meaning of the sentence did not immediately present itself. Instead, however, of slurring it over, as many would have done—

"'Gentlemen,' said he, 'I thought I had the meaning of this passage, but it has escaped me; I shall, therefore, be obliged to any one of you who will translate it.'

"A student thereupon instantly stood up in his place, and translated it to the doctor's satisfaction. He politely thanked him for it, and farther commended the young man for his spirited attempt. This incident had a powerful effect upon the minds of the other students, while all admired the candour of the professor; nor was there a single difficult passage which was not afterwards studied with more than usual care, that the next opportunity for distinction might be seized."

Act in this praiseworthy spirit, and you will lose nothing by renouncing the ridiculous claim to infallibility.

CORRESPONDENCE.

Area of Circles. M. C. J.—To find the area of a circle, multiply the circumference by half the diameter, and divide the product by two.

English Language in America. W. Thomson.—The language of the United States was imported from England into America in the reign of Queen Elizabeth.

Church Fonts. C. Jeffries.—Font is derived from *fons*, a fountain or water-spring. The rites of baptism were in primitive times performed in fountains and rivers.

Handwriting. J. C. Palmer.—Your writing is not sufficiently good to entitle you to teach others. It is not respectable for the teacher of the young to be a bad writer; nor can it ever become so, even should the majority of bad writers continue to increase. The teacher should take great pains to write a plain, legible hand. This is an essential qualification.

Hæmatinone. J. W. Heritage.—This kind of glass was in use with the ancients for the purpose of making ornamental vessels, mosaics, &c. It is described by Pliny, among others, and has been found pretty abundantly in the excavations at Pompeii. This glass is distinguished by its beautiful red colour, which lies between those of minium and of cinnabar. Hæmatinone contains no tin, or any other colouring matter, besides suboxide of copper. All attempts of the moderns to imitate it have hitherto entirely failed.

Gold-beater's Skin. R. E.—This substance is prepared from the outer membrane of the great gut of oxen. You are right in your supposition. It has the remarkable property that, although beaten with a hammer in the process of gold-beating for months together, yet it does not become extended in dimensions, nor yet thinner; indeed, it is at last discarded by the goldbeater because it gets too thick for his purpose.

Number of Species of Fishes. Robert.—The European salt and fresh waters contain 853 species of fish, of which the waters of Britain and Italy have only 100 in common. The species identical in the Mediterranean and Black Seas amount to no more than 27, notwithstanding the contiguity of the two basins, and direct intercommunication. Almost all the fish of the Caspian are specifially distinct from those in other parts of the globe.

Synonyms. G. Wilson.—Synonyms are words which have nearly the same meaning, sometimes the same general meaning, but a different specific shade of meaning; as, for example, *mix* and *blend*. Both these words denote a similar general meaning of putting things liquid or resembling liquids together; but when we speak of *mixing* two colours together, and of the colours of the rainbow *blending* with one another, the particular meaning is very different. *Mixing* makes two colours one; *blending* is their gradual, almost imperceptible running into one another.

The Roxburgh Club. W. Empson.—This Club was instituted in the year 1812, in commemoration of the sale of the library of John, Third Duke of Roxburghe, who died on the 19th of March, 1804. This sale continued for forty-two days, during which many of the most valuable books ever offered for public competition, were purchased at higher prices than had previously, or have since, been obtained.

Weak Sight and Short Sight. E. Tomkins.—The optical defects of the eye, which are capable of being corrected by lenses placed before it, are either a deficiency or an excess of their refractive power. Eyes which are deficient in refractive power, and which are called *near-sighted eyes*, are those which are not capable of converging the pencils proceeding from visible objects at the usual distances to a focus on the retina. Eyes, on the other hand, which have too great refractive powers, bring the rays proceeding from visible objects to a focus before they come to the retina, and are called *short-sighted eyes*, because objects which are near them are distinctly visible without the interposition of lenses.

The Harvest Mouse. A "Country Pupil."—The little creature you have described is the *Mus messorius*, or Field Mouse, otherwise called the Harvest Mouse. It is found in the Northern and South-western counties of England. The nest is curiously made in the interstices of the furrows of the field. White relates an instance of a nest sustained from a few stems of standing reeds, a precautionary expedient, probably. The annexed is an illustration of the nest.

Discoveries at Nineveh. James Dalton.—You had better read Dr. Layard's own account of his discoveries. The inscriptions on alabaster slabs and blocks, discovered by Layard, have been translated by Col. Rawlinson and Dr. Hincks, and corroborate the correctness of the Bible, and, what is very remarkable, the translations of the stone writing agree exactly with the sacred text in stating the amount of gold (thirty talents) taken by Sennacherib from Hezekiah, King of Judea. A chapter of intense interest to men of science in this work, describes the discovery of arched drains, vases, and kettles of copper; bronze bells, bronze cups; ivory and mother-of-pearl studs, fit for the shirt-bosom of a modern beau; a bronze strainer, &c.; in short, the Assyrians appear to have been better acquainted with the making of bronze vessels and figures than the moderns. Glass bowls were also discovered; but what is more interesting, is some *picks* and saws made of iron. This metal was long supposed to be unknown to the ancient Asiatics. Among the glass articles discovered was a rock crystal lens, with opposite convex and plane faces. It is the most ancient specimen of a magnifying and burning glass known.

Botany. W. S. C.—We cannot recommend you any *easy* method of obtaining a knowledge of botany. The attainment of any science is worth the labour. Your supposition that botany is difficult, on account of the long list of Latin names to be acquired, is erroneous, for these are few in number. If a science be worth learning, it is wise to begin properly, and study the "alphabet," as it may be called. In our next number we shall commence an enlarged series of the TUTOR with an original work on Descriptive British Botany, which you will find of great assistance in your studies.

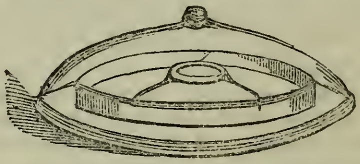
Hygiene. M. WALKER.—Hygeia was one of the four daughters of Esculapius, and was elevated by the ancients to the rank of goddess of health. It was thought to be the duty of the physician to prevent disease as well as to cure it; and a full expression was given to this sentiment by placing the daughter with the father on the same monument; several of the works of art now remaining have both figures thus represented. Of late years the moderns, equally with the ancients, have felt the necessity of the proper teaching and observance of the laws of health, and they have become a distinct branch of medical science under the name of hygiene.

Course of Reading. JAMES HELSHAM.—Your course of reading should be partly determined by the interest excited in your mind by accidental circumstances and conversations. When you have heard an animated discussion on the merits of certain standard works, with which you are unacquainted, that is the time to read them, whilst your mind is directed to the subject. If you are introduced to a foreigner, who discourses of his own country till he awakens an interest in scenes and manners that are new to you, follow up the impression by reading all you can find that relates to those subjects.

Arithmetical Questions. J. J. W.—We are pleased with the evident desire you evince to improve yourself in arithmetic; but such questions as you propose should be solved by yourself or the friends to whom you allude. We have neither time nor space to reply to them. Your solution of the question "if a barrel of flour will support twelve men for twenty-five days, how long will it support eight men?" is erroneous. We should consider it thus:—Since the flour will support 12 men 25 days, it would support 1 man 12 times 25 days, or 300 days; and since it would support 1 man 300 days, it will support 8 men $\frac{1}{8}$ of 300 days, or $37\frac{1}{2}$ days. Thus, to obtain the answer, we multiply 25 days by 12, and divide the product by 8. A little attention to the conditions of this question, and the process of the operation, will enable you to perceive at once that the answer is 12-8ths of 25 days.

Bills of Exchange. W. EDMUNDS.—There are four persons mostly concerned in the operations of a bill of exchange:—First, the *Drawer*, who receives the value, and is also called the *maker* and *seller* of the Bill. Second, the debtor upon whom the Bill is drawn, and who is called the *Drawee*. He also is called the *Acceptor*, after he accepts the Bill, which is an engagement to pay it when due. Third, the person who gives the value for the Bill, who is called the *Buyer*, *Taker* and *Remitter*. Fourth, the person to whom the Bill is ordered to be paid, who is called the *Payee*, and who may, by endorsement, pass it to any other person. These remarks apply chiefly to foreign bills of exchange.

Freezing and Boiling in a Vacuum. A. Z.—The process is simple. A little ether under an air-jar on the plate of the air-pump will flash into vapour as soon as the pressure is removed by working the pump; and water may be frozen by its own evaporation, over a good air-pump, arranged as in the figure. The water is contained in a watch-glass on a tripod, over a shallow dish of sulphuric acid, and the whole is covered by a low air-jar. On working the pump, the water evaporates so rapidly in the vacuum as to boil even at 72°; its vapour is instantly absorbed by the sulphuric acid, and in this way both the sensible and latent heat are removed so rapidly that the water is frozen solid while still apparently boiling.



The Harvest Moon. HENRY C. COLES.—The progress of the moon in her orbit from west to east being about 130° daily, she rises at the mean rate of nearly fifty minutes later every day than on that preceding. But in places of considerable latitudes, as our own country, this general rule is departed from, especially about the time of harvest, when the full moon rises for several nights only about twenty minutes later than the one preceding. The benefit thus conferred upon the husbandman, in having a greater share of natural light when employed in reaping and garnering the fruits of the earth, has acquired for the moon, under these circumstances, the title of the harvest moon. This phenomenon was observed by agriculturists long before it engaged the attention of astronomers, and regarded as an especial ordination of Providence for their benefit.

NATURAL PHILOSOPHY.

Second Division.

PROPERTIES OF LIGHT.—Optics.

CHAPTER XXXVI.—(*Continued.*)

Concave and convex mirrors are commonly ground to a spherical figure, though other figures, such as ellipsoids, paraboloids, &c., are occasionally used for special purposes. It is the properties of spherical concaves that we shall first describe.

The general action of a spherical mirror may be understood by regarding it as made up of a number of small plane mirrors, as A, B, C, D, E, F, G, Fig 218. On such a combination of small mirrors let rays emanating from R impinge. The different degrees of obliquity under which they fall upon the mirrors cause them to follow new paths after reflexion, so that they converge to the point S as to a focus.

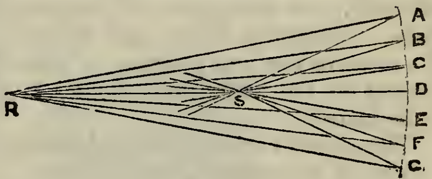


Fig 218.

The problem of determining the path of a ray after it has been reflected, is solved by first drawing a perpendicular to the surface at the point of impact, and then drawing a line on the opposite side of this perpendicular, making with it an angle equal to that of the angle of incidence of the incident ray. Thus, let *r*, *s*, Fig. 219, be an incident ray falling on any reflecting surface at *s*. To find the path it will take after reflexior, we first draw *s c*, a perpendicular to the surface at the point of impact, *s*. And then draw the line *s f* on the opposite side of the perpendicular *c s*, such, that the angle *c s f* is equal to the angle *c s r*. This is nothing but an application of the general law of reflexion, that the angles of incidence and reflexion are equal to one another, and are on opposite sides of the perpendicular.

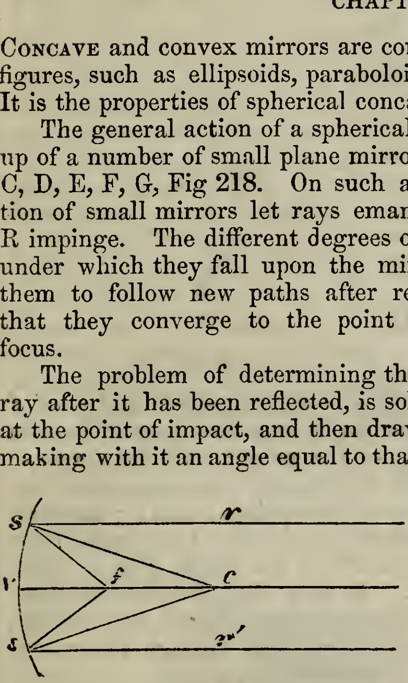


Fig. 219.

When rays of light diverge from the centre of a spherical concave mirror, after reflexion they converge back to the same point. For, from the nature of such a surface, lines drawn from its centre are perpendicular to the point to which they are drawn. Every ray, therefore, impinges perpendicularly upon the surface, and returns to the centre again.

When parallel rays of light fall on the surface of a spherical mirror, the aperture or diameter of which is not very large, they are reflected to a point half way between the surface and centre of the mirror. Thus let *r s r' s'* be parallel rays falling on the mirror *s s'*, the aperture *s s'*, of which is only a few degrees, these rays, after reflexion, will be found converging to the point *f*, which is called the *principal focus*, half way between the vertex of the mirror, *v*, and its centre *c*; for if we draw the radii, *c s c s'*, these lines are perpendiculars to the mirror at the points on which they fall; then make the angles *c s f* equal *c s r*, and *c s' f* equal *c s' r'*, and it is easy to prove that the point *f* is midway between *v* and *c*.

But if the aperture, *s s'*, of the mirror exceeds a few degrees, it may be proved geometrically that the rays no longer converge to the focus *f*; but, as the aperture increases, they are found nearer and nearer to the vertex, *v*, until finally, were it not for the opacity of the mirror, they would fall at the back of it. As this deviation is dependent on the spherical figure of the mirror, it is termed aberration of sphericity.

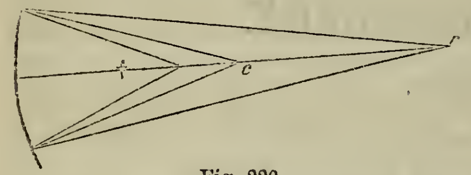


Fig. 220.

Conversely, if diverging rays issue from a lucid point, *f*, Fig. 219, half way between the vertex and centre of a spherical mirror of limited aperture, they will be reflected in parallel lines.

Rays coming from any point, *r*, Fig. 220, at a finite distance beyond the centre of the mirror, will be reflected so as to fall between the focus, *f*, and the centre, *c*.

Rays coming from a point, *r*, Fig. 221, between the focus, *f*, and the vertex, *v*, will diverge after reflexion. Under such circumstances a virtual focus, *f′* exists at the back of the mirror.

Concave mirrors give rise to the formation of images in their foci. This fact may be shown experimentally by placing a candle at a certain distance in front of such a mirror, and a small screen of paper at the focus. On this paper will be seen an image of the flame, beautifully clear and distinct, but inverted. The relative size and position of this image varies according to the distance of the object from the vertex of the mirror.

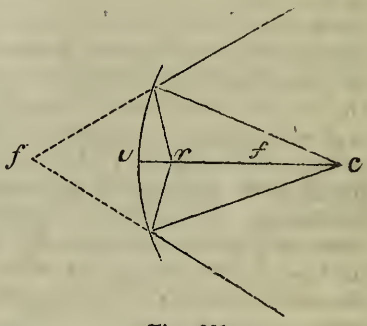


Fig. 221.

The second variety of curved mirrors is the convex; their chief properties are as follow:

When parallel rays fall on the surface of a convex mirror, they become divergent after reflexion; for let *s s′* be such a mirror, and *r s r′ s′* rays parallel to its axis falling on it, let *c* be the centre of the mirror, and draw *c s c s′*, which will be respectively perpendicular to the mirror at the points *s* and *s′*; then for the reflected rays, make the angle, *t s p*, equal to *p s r*, and the angle, *t′ s′ p′*, equal to *p′ s′ r′*. It may then be demonstrated, that not only do these reflected rays diverge, but if they be produced through the mirror till they intersect, they will give a virtual focus at *f*, half way between the vertex of the mirror, *v*, and its centre, *c*, so long as the mirror is of a limited aperture.

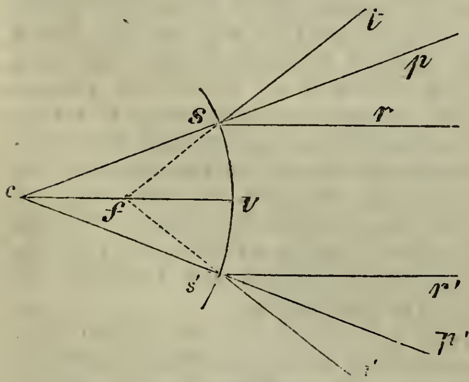


Fig. 222.

In a similar manner it may be proved that diverging rays, falling on a convex mirror become more divergent.

To avoid the effect of spherical aberration, it has been proposed to give to mirrors other forms than the spherical. Some are ground to a paraboloidal, and others to an ellipsoidal figure. Of the proporties of such surfaces I have already spoken, under the theory of undulations, in Chapter XXXI.; and the effects remain the same, whether we consider light as consisting of innumerable small particles, shot forth with great velocity, or of undulations arising in an elastic ether. In both cases parallel rays, falling on a paraboloidal mirror, are accurately converged to the focus, whatever the aperture of the mirror may be; and in ellipsoidal ones, rays diverging from one of the foci are collected together in the other. Occasionally, for the purposes of amusement, mirrors are ground to cylindrical or conical figures; they distort the appearance of objects presented to them, or reflect, in proper proportions, the images of distorted or ludicrous paintings.

CHAPTER XXXVII.

REFRACTION OF LIGHT.

Refractive Action described—Law of the Sines—Relation of the Refractive Power with other Qualities—Total Reflexion—Rays on plane Surfaces—The Prism—Action of the Prism on a Ray—The Multiplying-glass.

When a ray of light passes out of one medium into another of a different density, its rectilinear progress is disturbed, and it bends into a new path. This phenomenon is designated the refraction of light.

Thus, if a sunbeam, entering through a small hole in the shutter of a dark room, falls on the surface of some water contained in a vessel, the beam, instead of passing on in a straight line, as it would have done had the water not intervened, is bent or broken at the point of incidence, and moves in the new direction.

In the same way, also, if a coin or any other object, O, Fig. 223, be placed at the bottom of an empty bowl, A B C D, and the eye at E so situated that it cannot perceive the coin, the edge of the vessel intervening, if we pour in water the object comes into view; and the cause of this is the same as in the former illustration: for while the vessel is empty the ray is obstructed by the edge of the bowl, as at O G E, but when water is poured in to the height F G, refraction at the point L, from the perpendicular, P Q, ensues; and now the ray takes the course O L E, and entering the eye at E, the object appears at K, in the line E L K. For the same reason oars or straight sticks immersed in water look broken, and the bottom of a stream seems at a much less depth than what it actually is.

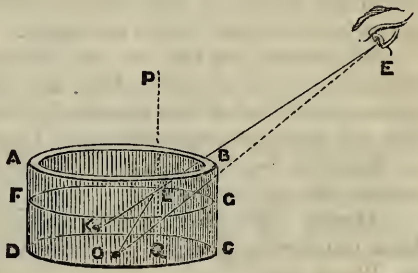


Fig. 223.

The same result ensues under the circumstances represented in Fig. 224, in which E represents a candle, the rays of which fall on a rectangular box, A B C D, under such circumstances as to cast the shadow of the side A C, so as to fall at D. If the box be now filled with water, everything remaining as before, the shadow will leave the point D and go to *d*, the rays undergoing refraction as they enter the liquid; and if the eye could be placed at *d*, it would see the candle at *e*, in the direction of *d* A produced.

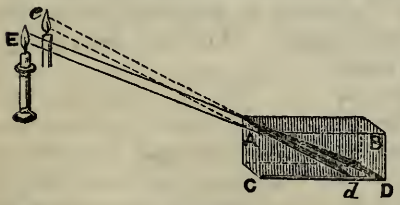


Fig. 224

Let N O, Fig. 225, be a refracting surface, and C the point of incidence of a ray, B C, C E the course of the refracted ray, and C K the course the ray would have taken had not refraction ensued. With the point of incidence, C, as a centre, describe a circle, N M O G, and from A and R draw the lines A D, R H at right angles to the perpendicular M G to the point C. Then A C M will be the angle of incidence, R C G the angle of refraction; A D is the sine of the angle of incidence, and H R the sine of the angle of refraction. Now in every medium these lines have a fixed relation to one another and the general law of refraction is as follows:—

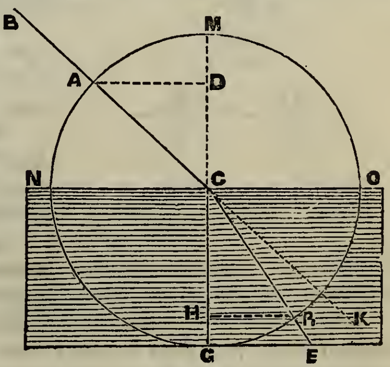


Fig. 225.

In each medium the sine of the angle of incidence is in a constant ratio to the sine of the angle of refraction; the incident, the perpendicular, and the refracted ray are all in the same plane, which is always at right angles to the plane of the refracting medium.

To a beginner, this law of the constancy of sines may be explained as follows :—Let C D, Fig. 226, be a ray falling on a medium, A B, in the point D, where it undergoes refraction and takes the direction D E. Its sine of incidence, as just explained, is C *g*, and its sine of refraction E *e*; and let us suppose that the medium is of such a nature that the sine of refraction is one-half the sine of incidence—that is, E *e* is half C *g*. Moreover, let there be a second ray, H D, incident also at the point D, and refracted along D F ; H *h* will be its sine of incidence, and F *f* its sine of refraction; and by the law F *f* will be exactly one half H *h*. The proportion or relation between these sines differs when different media are used, but for the same medium it is always the same. Thus, in the case of water, the proportion is as 1·366 to 1 ; for flint-glass, 1·584 to 1 ; for diamond, 2·487 to 1. These numbers are obtained by experiment. They are called the indices of refraction of bodies, and tables of the more common substances are given in the larger works on optics.

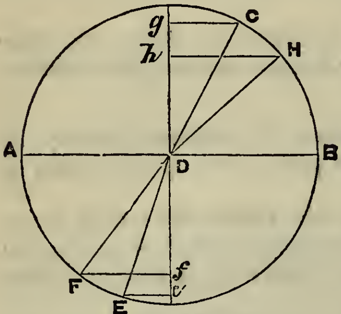


Fig. 226.

No general law has as yet been discovered which would enable us to predict the refractive power of bodies from any of their other qualities; but it has been noticed that inflammable bodies are commonly more powerful than incombustible ones, and those that are dense are more energetic than those that are rare.

When a ray of light passes out of a rare into a dense medium, it is refracted *toward* the perpendicular. Fig. 224 is an illustration—the rays passing from air into water. But when a ray passes from a dense into a rarer medium, it is refracted *from* the perpendicular. Fig. 223 is an example—the rays passing from water into air.

In every case, when a ray falls on the surface of any medium whatever, it is only a portion which is transmitted, a portion being always reflected. If in a dark room we receive a sunbeam on the surface of some water, this division into a reflected and a refracted ray is very evident: and when a ray is about to pass out of a highly refractive medium into one that is less so, making the angle of incidence so large that the angle of refraction is equal to or exceeds 90°, total reflexion ensues. This may be readily shown by allowing the rays from a candle, *f*, or any other object, to fall on the second face, *b c*, of a glass prism, *a b c*, Fig. 227 ; the eye placed at *d* will receive the reflected ray, *d e*, and it will be perceived that the face *b c* of the glass, when exposed to the daylight, appears as though it were silvered, reflecting perfectly all objects exposed to its front, *a c*.

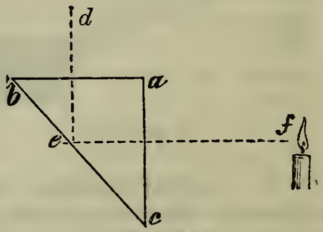


Fig. 227.

As with the reflexion of light, so with refraction—it is to be considered as taking place on plane, convex, and concave surfaces.

When parallel rays fall upon a plane refracting surface they continue parallel after refraction. This must necessarily be the case, on account of the uniform action of the medium.

If divergent rays fall upon a plane of greater refractive power than the medium through which they have come, they will be less divergent than before. Thus, from the point *a* let the rays *a b*, *a b′* diverge ; after suffering refraction they will pass in the paths *b c*, *b′ c′*, and if these lines be projected, they will intersect at *a′*, but *a′ b*, *a′ b′* are less divergent than *a b*, *a b′*.

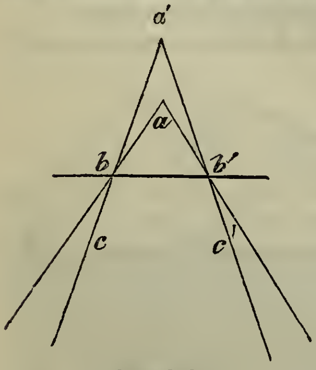


Fig. 228.

If, on the contrary, rays pass from a medium of greater to one of less refractive power, they will be more divergent after refraction. For this reason bodies under water appear nearer the surface than they actually are.

When parallel rays of light pass through a medium bounded by planes that are parallel, as through a plate of glass, they will continue still parallel to one another, and to their original direction, after refraction. For this reason, therefore, we see through such plates of glass objects in their natural positions and relation.

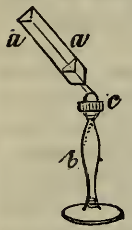


Fig. 229.

The optical prism is a transparent medium, having plane surfaces inclined to one another. It is usually a wedge-shaped piece of glass, *a a*, Fig. 229, which can be turned into any suitable position, on a ball and socket-joint, *c*, and is supported on a stand, *b*. As this instrument is of great use in optical researches, we shall describe the path of a ray of light through it more minutely.

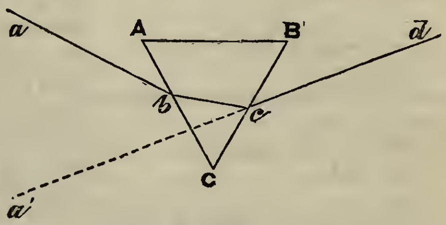


Fig. 230.

Let, therefore, A B C, Fig. 230, be such a glass prism seen endwise, and let *a b* be a ray of light incident at *b*. As this ray is passing from a rarer to a denser medium it is refracted toward the perpendicular to an extent dependent on the refractive power of the glass of which the prism is composed, and therefore pursues a new path, *b c*, through the glass; at *c* it again undergoes refraction, and now passing from a denser to a rarer medium, takes a new course, *c d*. To an eye placed at *d*, and looking through the prism, an object, *a*, seems though it were at *a'*, in the straight line *d c* continued. Through this instrument, therefore, the position of objects is changed, the refracted ray, *c d*, proceeding toward the back, A B, of the prism.

But the prism in actual practice gives rise to far more complicated and interesting effects, to be described hereafter, when we come to speak of the colours of light.

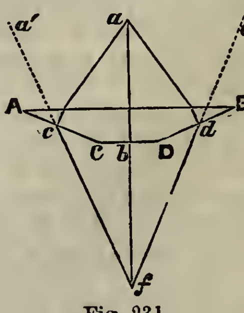


Fig. 231.

The multiplying-glass is a transparent body, having several inclined faces. Its construction and action are represented at Fig. 231. Let A B be a plane face, C D also plane and parallel to it, but A C and D B inclined. Now let rays come from any object, *a*, those, *a b*, which fall perpendicularly on the two faces will pass without suffering refraction; but those, *a c*, *a d*, which fall on the inclined faces will be refracted into new paths, *c f*, *d f*, these portions acting like the prism heretofore described. Consequently an eye placed at *f* will see three images of the object in the direction of the lines along which the rays have come—that is, at *a'*, *a*, *a''*. Hence the term *multiplying-glass*, because it gives as many figures of an object as it has inclined surfaces.

CHAPTER XXXVIII.

THE ACTION OF LENSES.

Different Forms of Lenses—General Properties of Convex Lenses—General Properties of Concave Lenses—Analogy between Mirrors and Lenses—Production of Images by Lenses—Size and Distance of Images—Visual Angle—Magnifying Effects—Burning Lenses.

Transparent media having curved surfaces are called lenses. They are of seven different kinds, as represented in Fig. 232. The plano-convex lens, 3, has one surface plane and the other convex; the plano-concave, 5, has one surface plane and the other concave; 2 is the double convex; 4 the double concave; 7 the meniscus; 1 the sphere, or globe; and 6 the concavo-convex.

For optical uses lenses are commonly made of glass, but for certain purposes other substances are employed. For example, rock crystal is often used for making spectacle lenses; it is a hard substance, and is not, therefore, so liable to be scratched or injured as glass.

In a lens the point *c* is called the *geometrical centre*, for all lenses are ground to spherical surfaces, and *c* is the centre of their curvature; the aperture of the lens is *a b*, and *d* is its *optical centre*; *f e* is the axis, and any ray, *m n*, which passes through the optical centre, is called a principal ray.

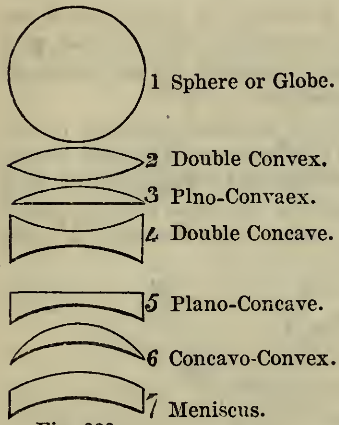


Fig. 232.

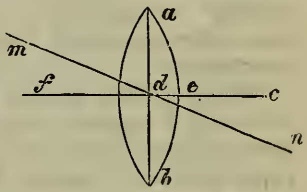


Fig. 233.

The general action of lenses of all kinds may be understood after what has been said in relation to the prism, of which it was remarked that the refracted ray is bent toward the back. Thus, if we have two prisms *a c e*, *b c e*, placed back to back, and allow parallel rays of light, *m n*, to fall upon them, these rays, after refraction, being bent from their parallel path toward the back of each prism, will intersect each other in some point, as *f*. Now, there is obviously a strong analogy between the figure of the double convex lens, and that of these two prisms; indeed, the former might be regarded as a series of prisms with curved surfaces, and from such consideration it is clear, that when parallel rays fall on a convex lens, they will converge to a focal point.

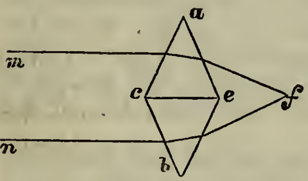


Fig. 234.

Again, let us suppose that a pair of prisms be placed edge to edge, as shown in Fig. 235, and that parallel rays, *m n*, are incident upon them. These rays undergo refraction, as before, toward the back of their respective prisms, *b c*, *d e*, and therefore emerge divergent, as at *f* and *g*. Now, there is an analogy between such a combination of prisms and a concave lens, and we therefore see that the general action of such a lens upon parallel rays is to make them divergent.

By the aid of the law of refraction it may be proved that lenses possess the following properties:

Every principal ray which falls upon a convex lens of limited thickness is transmitted without change of direction.

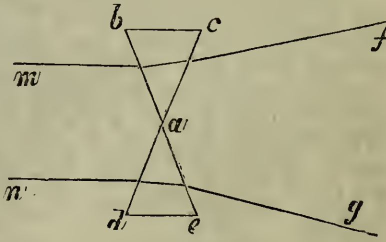


Fig. 235.

Rays parallel to the axis of a double equi-convex glass lens are brought to a focus at a distance from the optical centre equal to the radius of curvature of the lens. But if it be a plano-convex glass, the focal distance is twice as great. The focus for parallel rays is called the principal focus.

Rays diverging from the principal focus of a convex lens after refraction, become parallel.

Rays diverging from a point in the axis more distant than the principal focus converge after refraction, their point of convergence being nearer the lens as the point from which they radiated was more distant.

Rays coming from a point in the axis nearer than the principal focus diverge after refraction.

With respect to concave lenses, the chief properties may be described as follows:—

Every principal ray passes without change of direction.

Rays parallel to the axis are made divergent. Thus *m n*, Fig. 236, being parallel rays falling on the double concave, *a b*, diverge after refraction in the directions *g d*; and if they be produced give rise to a virtual or imaginary focus at *f*.

By concave lenses diverging rays are made still more divergent.

When the effects of lenses are compared with those of mirrors, it will be found that there is an analogy in the action of concave mirrors and convex lenses, and of convex mirrors and concave lenses.

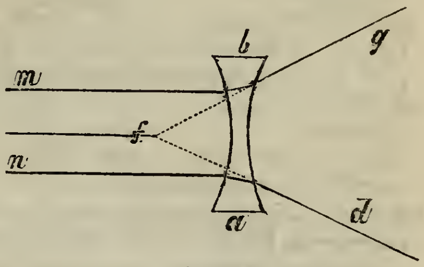


Fig. 236.

It has already been remarked that concave mirrors give images of external objects in their focus. The same holds good for convex lenses. Thus, if we take a convex lens, and place behind it, at the proper distance, a paper screen, we shall find upon that screen beautiful images of all the objects in front of the lens in an inverted position. The manner in which they form may be understood from Fig. 237. Where L′ L is a double convex lens, M N any object, as an arrow, in front of it, the lens will give an inverted image, *n m*, of the object at a proper distance behind. From the point M all the rays, as M L, M C, M L′, after refraction, will converge to a focus, *m*; and from the point N all rays, as N L, N C, N L′, will likewise converge to a focus, *n*; and so, for every intermediate point between M and N, intermediate foci will form between *m* and *n*, and therefore conjointly give rise to an inverted image.

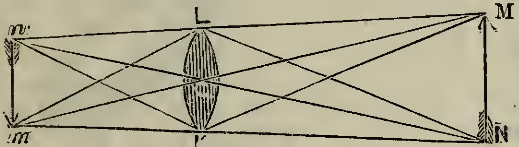


Fig. 237.

The images thus given by lenses or mirrors may be made visible by being received on white screens or on smoke rising from a combustible body, or directly by the eye placed in a proper position to receive the rays. They then appear as if suspended in the air, and are spoken of as aërial images.

The distance of such images from a lens, and also their magnitude, vary with circumstances.

If the object be very remote, it gives a minute image in the focus of the lens; as it is brought nearer, the image recedes farther, and becomes larger; when it is at a distance equal to twice the focal distance, the image is equidistant from the lens on the opposite side, and is of the same size as the object. As the object approaches still nearer, the image recedes, and now becomes larger than the object. When it reaches the focus, the image is at an infinite distance, the refracted rays being parallel to one another. And, lastly, when the object comes between the focus and the surface of the lens, an erect and magnified image of the object will appear on the same side of the lens as the object itself. Hence convex glasses are called magnifying glasses.*

From these considerations it therefore appears that the magnifying power of lenses is not, as is often popularly supposed, due to the peculiar nature of the glass of which they are made, but to the figure of their surfaces. The dimensions of all objects depend on the angles under which they are seen. A coin at a distance of 100 yards appears of a very small size; but as it is brought nearer the eye, its size increases, and when only a few inches off, it can obstruct the view of large objects. Thus, if A represents its size at a remote distance, the angle D E F, or the visual angle, is the angle under which it is seen; when brought nearer, at B, the angle is G E H; and at C, increases to I E K. In all cases the apparent size of an object increases as the visual angle increases, and all objects become smaller as their distances increase; and any optical contrivances, either of lenses or mirrors, which can alter the angle at which rays enter the eye, and make it larger than it would otherwise be, magnify the objects seen through them.

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* The recent researches of Mr. Layard, at Nineveh, tend to prove the antiquity of magnifying glasses. He discovered one possessing this property in one of the temples; and Sir David Brewster, who has inspected it, pronounces that it is a decided and designed magnifying glass. The opinion of the philosopher confirms the previous supposition of Mr. Layard and various students, that the cuneiform and many other inscriptions, and also the smaller sculptures, which are so minute as to be almost unintelligible without a magnifying glass, could only have been executed by the aid of powerful magnifying glasses.

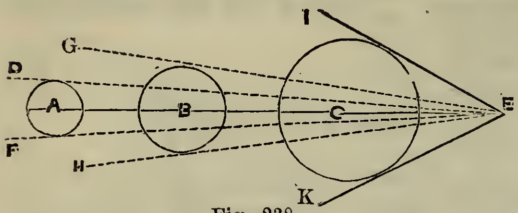

Fig. 238.

On these principles concave mirrors and convex lenses magnify, and convex mirrors and concave lenses minify.

From their property of converging parallel rays to a focus, convex lenses and concave mirrors have an interesting application, being used for the production of high temperatures, by converging the rays of the sun. Fig. 239 represents such a burning-glass. The parallel rays of the sun falling on it are made to converge, and this convergence may be increased by a second smaller lens. At the focal point any small object being exposed, its temperature is instantly raised. In such a focus there are few substances that can withstand the heat—brick, slate, and other such earthy matters instantly boil, metals melt, and even volatalize away. During the last century some French chemists, using one of these instruments, found that when a piece of silver is held over gold fused at the focus, it became gilded over by the vapour that rose from the melted mass. And in the same way gold could be whitened by the vapours of melted silver. The heat attained in this way far exceeds that of the best constructed furnace.

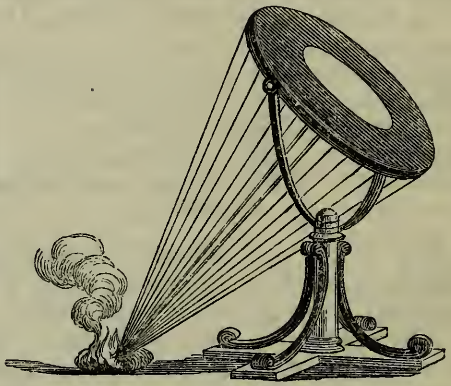

Fig. 239.

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NATIONAL SOCIETY'S TRAINING SCHOOL FOR SCHOOLMISTRESSES.

The last annual report of this laudable institution presents a very favourable account of its prosperity. At the Christmas examination of students and pupil-teachers, which took place before Her Majesty's inspector of schools, twenty-nine students obtained certificates of merit. Of forty pupil-teachers who competed for Queen's scholarships, twenty-five were successful. Some of the pupils had been permitted to enter for a single year's training; but in the opinion of the council, the course of training, to produce permanent and satisfactory results, requires a period of not less than two years. The applications for admission at the beginning of the year were so numerous that it was found necessary to make a selection, and 107 students were received into Whitelands. Among other alterations the practising schools have been placed under the superintendence of Mr. Knighton, the teacher of the art of teaching; and the attention of the students is more largely called to the study of the best methods of teaching, and to the principles which should guide them in their professional career, more time being devoted to private study and reproduction of the lectures that are given to them. They are also carefully instructed in the subject of domestic economy, great attention being bestowed upon their industrial training. The report also stated, in conclusion, that most gratifying reports had been received of the success of former students.

ON THE STUDY OF EUCLID.

II.—DEFINITIONS—AXIOMS—POSTULATES.

THE introductory article, given under this head in the last number of the FAMILY TUTOR, contained a few general remarks on the strictly abstract character of pure geometry. It was expressly declared that the subject-matter of our reasonings in this science is not the rough and imperfect figures pictured to the eye on paper; these are merely the outward representations, or visible symbols, of the purely mental conceptions which they very conveniently serve to suggest; though, from the physical and instrumental imperfections which we know to be attached to them, they are not accurately the things themselves; these latter, by an act of abstraction, being freed from all material encumbrances; so that, in fact, the forms and figures of geometry are exclusively in the *mind*, and not in *matter*.

In the preliminary remarks referred to, no particular class of readers was had more especially in view; they were submitted indifferently as well to teachers as to learners; but we shall now assume our more legitimate function, that of a *Tutor;* and shall address ourselves more particularly to that portion of our readers for whom our publication is confessedly designed—to *learners*.

And as it appears very awkward for a *Tutor*, when instructing his *pupils*, to be calling himself *we*, I shall henceforth address *you* (that is, *my pupils*) in the first person.

Now you will understand that I am not going *here* to teach you geometry, or to conduct you step by step through Euclid's Elements. All that I undertake to do, is to throw a gleam or two of light upon the more obscure parts of the path you yourself are travelling; to remove occasionally an obstacle out of your way; but above all, I hinted at the outset to try to imbue you with the proper spirit in which the journey should be undertaken and pursued.

Supposing, then, that you have your Euclid in your hands, I proceed, first, to direct your attention to the fact, that the work is divided into distinct sections, or *Books;* and that each book commences with an explanation of the technical terms employed in it, with a concise but satisfactory description of the lines and figures to be reasoned about; with a statement of the elementary operations to be *admitted as possible,* in the practical constructions, and of the elementary propositions to be *admitted as true,* in the reasonings.

You will at once see that, in entering upon any doctrine that is to be established, not by the influence of authority, but by the force of reasoning and sound argument, it is of much importance that preliminaries such as these should be clearly and satisfactorily settled. If a person desire to communicate his own convictions to another, and in undertaking to do so make reasoning the only channel through which to convey them, there must be—first, a mutual concurrence as to the meaning of the terms employed; and secondly, a like concurrence as to the fundamental principles to be assumed by the one party, and admitted by the other. A good deal of what goes by the name of reasoning and argument, in the common affairs of life, is nothing but a sort of wrangling disputation, solely from the neglect to establish a clear understanding on these points at the outset. Euclid is careful to preclude this fertile source of ambiguity, confusion, and error. He commences the several portions of his subject with *Definitions* of the things to be discussed, and of the peculiar terms to be employed in the discussion; he then tells you what he expects you to admit as practically, or at least as conceivably possible; and lastly, what he requires you to concede, without demonstration, as necessarily true.

You must not hurry over the definitions; they have been framed with great care. The character of a good definition is this: that it is just sufficiently descriptive of the thing defined to distinguish it from all other things, but not more than sufficient for this purpose. If anything more than what merely suffices to identify the object defined be declared in a definition, that definition is said to be *redundant:* it involves the *assumption* of some property or peculiarity of the object, which it is the province of *reasoning* to deduce from the properly-restricted definition of it. All the properties of geometrical figures are in this way deduced from, or, as it were, drawn out of, the definitions of those figures; for in the definitions they are all virtually implied, and lie concealed. If you were to define an equilateral triangle as that which has three equal sides and three equal angles, you would make a statement which is quite correct—as a *statement*, but very faulty as a *definition:* the equality of the three sides *necessitates* the equality of the three angles; so that the equality of the angles is virtually implied in the equality of the sides: a truth which must be discovered to us by reasoning, not assumed in a so-called definition. You will observe that Euclid invariably constructs his figures solely in reference to the descriptions of those figures embodied in the definitions, quite regardless, at the time, of all other properties of them; and you will perceive that he has furnished particulars just sufficient for this purpose, without one superfluous item.* Having thus previously established the *existence* of his geometrical forms, he then proceeds, in his *Theorems*, to deduce, by reasoning, all those properties necessarily, though not obviously, implied in the definitions.

It must be noticed, however, that before the constructions employed by Euclid in his *Problems* can be actually effected, assent must be given to the practicability, or, to be more explicit, to the conceivability of certain fundamental *operations;* these are enumerated in the *Postulates;* and that before the reasonings in his *Theorems* can be entered upon, assent must, in like manner, be given to certain fundamental and necessary *truths;* these are enumerated in the *Axioms.* You perceive, therefore, that the definitions furnish the raw material worked *upon*, and that the postulates and axioms furnish the implements worked *with;* the postulates supplying the elements of the constructions, the axioms the elements of the reasonings.

And here I must caution you against a very prevalent mistake. Do not for a moment imagine that Euclid required his postulates to be *granted* because the fundamental operations, under that head, are so easy of performance; nor that his axioms are to be assented to because the truths so-called are so easy of proof; his reasons for these preliminary stipulations were of a directly opposite kind; he bargains with you to grant the possibility of his fundamental problems (the postulates), solely because he is unable, practically, to perform them; and he calls upon you to admit, without proof, his fundamental theorems (the axioms) solely because he is unable to demonstrate them. A postulate and an axiom should each have a two-fold character; a postulate should be a conceivable, but at the same time a really impracticable *operation;* an axiom should be a self-evident, but at the same time an indemonstrable *truth.* Euclid asks us to "*grant* that a straight line may be drawn from any one point to any other," from sheer necessity; the apparent simplicity of the operation is in reality a cause of its difficulty. What operation, still more simple, could be made subsidiary to the drawing of a straight line? And how could he direct the performance of the latter, without some operation still more elementary? Besides, an isolated straight line, according to Euclid's strict definition, has no visible or external existence. Euclid's *line* is merely the abstraction *length;* and length, unaccompanied by other dimensions, cannot of course be actually exhibited. The finest line that you or I could draw upon paper, would be a solid bar of ink; and the finest line an artist could engrave upon steel, would be a sunken channel, with both breadth and depth. You may possibly think that, as the physical or material lines, here adverted to, are so very slender, it is not worth while to make any objection to them on the score of their width or thickness; but the "near enough," or the "that'll do" system, has no place whatever in *Euclid's* system, which is one of rigid, uncompromising accuracy. A line that you could draw and exhibit would no more be regarded as a line that Euclid had defined, than a beam of timber would be so regarded. Remember that with *him* "a miss is as good as a mile."

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* It need scarcely be stated that, in speaking of Euclid here, the emendations of Simson and other modern editors are uniformly kept in view. It is much to be regretted that, in the editions of Euclid most generally studied, acknowledged blemishes are allowed to remain in the text, while the proper emendations are given in the form of notes at the end. Our veneration for a writer on science should never be considered as ground sufficient for us to endorse his errors and defects, nor even to except to them only indirectly, and in the form of supplementary annotation; they ought, in justice to him, as well as to those for whom he wrote, to be expunged from the text of his instructions. In a work of taste or imagination, the case would be different; an editor would have no right to replace the author's views and peculiarities by his own; but a book of science, so extensively used in education as Euclid is, should be rendered as perfect as possible; and an editor of such a book could incur little blame for expunging every admitted blemish from the text of his author.

As with the postulates, so with the axioms; they are inserted from necessity, and solely because Euclid was unable to demonstrate them. That self-evidence alone was not considered by him as sufficient to justify the claim of a proposition to a place among the axioms, is plain from his uniform practice of demonstrating whatever can be demonstrated, and assuming only what cannot; taking care, however, *in general,* that the truth assumed shall be not only an ultimate truth, but also a thing perceived to be true as soon as enunciated. I say *in general,* because there is one remarkable exception—the 12th axiom of the first book is indemonstrable, but not self-evident; it has one of the characteristics of an axiom, but not the other. I would recommend you to pay no regard to this so-called axiom till you reach the 29th proposition; because, up to that point, its aid is not required, and because, moreover, arguments, abundantly sufficient to produce full conviction of its truth, may be adduced *then;* though they could not have been employed at the opening of the subject. This I shall show you hereafter.

Now you must not be surprised or disappointed that geometry—pre-eminently the science of demonstrated truth—should thus require to rest upon principles which must be gratuitously admitted. No reasoning process whatever can even be conceived to exist, unsupported by a like foundation. A proposition may be affirmed on the one side, and denied on the other; but the matter cannot be reasoned out—it cannot be *argued,* unless some common first principle or principles be at the outset agreed to by both parties. If everything be denied, there may be assertion and contradiction, dispute and altercation, but certainly no *argument.* The noticeable thing in Euclid's first principles, or axioms, is, that with the exception mentioned above they are such as nobody in his senses would think of controverting, inasmuch as the truth of them is self-evident; and that is so immediately obvious, that nothing of the kind, anterior to them in obviousness and simplicity, can possibly be adduced; for if anything could, then *that* thing—being the more simple and elementary—would itself become the axiom, or first principle, by aid of which the former might be demonstrated. You see, therefore, that it is essential to the very nature of an axiom that it should be too simple and elementary to admit of demonstration by help of anything more simple and elementary. The axioms are, on this account, self-evident undemonstrable truths. Proposition II. of Book III.—namely, that "If any two points be taken in the circumference of a circle, the straight line which joins them shall fall *within* the circle," is a proposition as self-evident, to any one who has a clear conception of a circle, as that which affirms that "two straight lines cannot inclose a space;" but as it is demonstrable, it is very properly placed in the body of the work.

What has now been said must suffice for the present. The subject will be resumed in a future number.

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LESSONS IN NATIONAL HISTORY.

No. I.

When rust shall eat her brass, when time's strong hand
Shall bruise to dust her marble palaces,
Triumphant arches, pillars, obelisks—
Nay, Rome itself shall not be found at all—
HISTORIANS' books shall live.

HISTORY is precept teaching by example; and at the last general meeting of the COLLEGE OF PRECEPTORS, the chairman, in his address to the assembled members, forcibly impressed upon them "the necessity of paying particular attention to the proper teaching of HISTORY." The books at present in use (he observed) were inadequate, and not the kind which were required for the purposes of school education. He thought that in all probability no school book suited to that purpose would make its appearance until some person (who had experience in teaching, was himself one of the literati, and whose judgment was capable of tracing back effects to their causes) should undertake to complete it. He, however, looked forward to the time when they would more earnestly direct their attention to historical study, and when they might be able so say, that never until then had there come forth a work from which history could be properly taught and learned. He wished to suggest to the members that history was a matter to which they might direct their attention with the greatest profit to themselves. Those of them who were classical scholars would learn how closely philology was connected with history. Those who were mathematical scholars might find in the reading of it a recreation from their severer studies; while both of them would rise from it better prepared either publicly or privately to pursue their profession of educators.

"History," says Hume, "is not only a valuable part of knowledge, but it opens the door to many other parts, and affords material to most of the sciences. A man acquainted with history may, in some respect, be said to have lived from the beginning of the world, and to have been making continual additions to his stock of knowledge in every country."

RUSSIA AND TURKEY.

We shall commence our historical sketches of National History by taking a brief review of two mighty empires, whose respective positions in the great map of the world are now occupying the most anxious attention of the civilized nations of Europe. Let the tutor of youth, or the historical student, place a geographical map on the one hand, and a chronological stream, or chart of history, on the other. Then let him carry his imagination up the stream of time for four centuries; and he will behold two vast regions—one within the frozen circles of the north, immersed in barbarism, and enveloped in the darkest obscurity—and the other the all dominant mistress of the Eastern world, before whose victorious legions the imperial city of the Cæsars fell prostrate, and Christian nations quailed before the ensanguined banner of the crescent. Let the student then carry his imagination two centuries forward—and what a striking change presents itself! A more potent lesson, on the rise, the zenith, and the fall of nations, could not be presented to the mind of the ethnological inquirer. The barbarians of the Neva, the Don, and the Wolga had emerged from their obscurity; and by their national energy, and the genius of their rulers, they gradually advance in the scale of civilization, and at length become sufficiently powerful to threaten the very political existence of their once formidable neighbours.—On the other hand, the descendants of Othman and Solyman, who for ages possessed absolute sway over the finest regions of Europe, Asia, and Africa, have, for the last two centuries, been rapidly sinking into comparative nihility. The crescent of Mahomet has been gradually waning before the rising glories of the cross. To re-adopt the language of Mahomet II. on his capture of Constantinople, "The spider hath spun its web in the imperial palaces of the Cæsars," and the owl sings "its requiem over their desolated ruins."

The records of Europe afford us little information on the early history of Russia, which, previous to the last four centuries, is involved in traditional obscurity. We read of a celebrated Prince of the name of Rurik, in the 9th century, and in the 11th of Vladimir the Great, who embraced the Christian religion, according to the Greek Church. But the annals of these ages are uninteresting, as well from their obscurity, as from the civil wars and sanguinary revolutions by which they were marked. Nor does it appear that any of the states existing in the vast tract of country now called European Russia were considerable. Kiev, a town never much larger than at present, was long the Russian capital.

In the 13th century the seat of government was transferred to Moscow; but in 1382, that city was taken, after a short siege, by Tamerlane, and again in 1571 by the Tartars, who burnt it.

On the extinction of the reigning dynasty in 1598, by the death of the Czar Theodore, civil dissensions broke out, and continued till 1613, when Romanof, descended in the female line from the previous dynasty, was raised to the throne, and succeeded in restoring tranquillity to Russia. His son Alexis, a prince of ability, recovered part of the provinces lost in preceding disorders, and might have made considerable progress in introducing civilisation among his subjects, had he not died in 1675, in the prime of life. He left three sons, of whom the youngest was the celebrated Peter I. The eldest dying, and the second being of weak intellect, the sovereignty was vested, in 1682, in Peter, in conjunction with his brother; but after the death of the latter, in 1692, Peter reigned alone. His education, conducted by foreigners, had taught him the importance of introducing the arts, and knowledge of other nations, into Russia. With that view he travelled in the latter years of the 17th century into Holland, Germany, and other parts of Europe. In the coalition against Charles XII. of Sweden, the Russian troops gave way before the impetuosity of their antagonist; but on the invasion of Russia by that monarch, in 1708 and 1709, fortune favoured the arms of Peter, and he recovered all the north-western provinces that had been wrested from him. These were confirmed by the peace with Sweden in 1721, by which time considerable progress had been made in the introduction of discipline into the army—in the establishment of schools—in the construction of ships of war —and in the building of a new capital, which was named "Petersburg," in honour of the founder's name. He was the first Russian Prince who took the Greek Church under his especial protection, and his successors still lay claim to that right. Peter, commonly surnamed "the Great," died in 1725, in his 53rd year, and was succeeded by his wife, Catherine I., who reigned only two years, and her son, Peter II., who reigned only three. Anne, a niece of Peter, came to the throne in 1730, and reigned until 1740, and was succeeded by Joan III., a child, who bore the name of sovereign scarcely two years. But the reign of Elizabeth, daughter of Peter I., who came to the throne in 1742, lasted twenty years, and proved a period of considerable splendour. She died in 1762, and was succeeded by Peter III., a weak Prince, who lost both his throne and his life in the first year of his reign, by one of those court conspiracies so common in Russia. From that time the imperial power was vested in his widow, the well-known Catherine II. Under her the energy of the Russian arms became apparent, baffling in the north the efforts of the Swedes, and triumphing in the south over the fanatic valour of the Turks. Under her, also, took place the partition of Poland. She died in 1796, leaving her throne to her son, the feeble and vacillating Paul I., who took part in the second coalition against France. The campaign of 1799 first brought the Russian and French arms into contact. In Italy, under Suwarrow, the Russians were victorious; but in Switzerland, led by a less able chief, Korsakof, they were defeated. The contest was cut short by the caprice of Paul, who recalled his troops in the beginning of 1800, and continued at home a course of innovation so unjust and absurd, as to excite general disgust, and to lead to the formation of that conspiracy which, in the summer of 1801, deprived him of his life. His son, Alexander, preserved peace, until the continued aggressions of Bonaparte led to the formation of the second coalition in 1805. This was followed by the battle of Austerlitz, in which the French were completely successful. A pause now took place in the hostilities, until the conquest of Prussia in the succeeding year brought the French into Poland, and renewed, for the third time, the shock between these formidable assailants. The successes of the French at Pultusk, at Gomglin, at Eylau, and finally at Friedland (14th June, 1807,), led to the peace of Tilsit. This lasted till 1812, when the fourth great struggle between France and Russia took place. The latter, aided by her allies, was irresistible in the open field; but the plan pursued by the Russians, of yielding ground and destroying supplies, together with a concurrence of circumstances which no combination could have procured, proved eminently successful; and of the mighty host which Bonaparte led into Russia, scarce 50,000 returned. In the great event that ensued, the Russians maintained their former character.

The campaign of 1815 was too short to require much display of their military qualities, and since that year their government has wisely abstained from war, postponing to a future day the execution of those hostile designs against Turkey, which has long formed the grand object of Russian ambition; and which the present Emperor Nicholas, brother of the late Alexander, appears determined to pursue. At the present time there are, in the Court of Petersburg, two leading political parties—the Russian and the German. The former cherishes the idea of extended domination in eastern Europe, with the absorption of Turkey. The scheme of the German party —of which Count Nesselrode is the leader— is to aggrandise the influence of Russia in the west—in the affairs of Germany, for instance, as especially manifested in the events of 1848 and 1849. Prince Menchikoff, the Minister of Marine, and Governor-General of Finland, belongs to the Russian party; and he supports the influence of the Greek Church as the principal lever of Russian action in the Orient. He belongs to the very front rank of the public men of Russia; and is one of those admitted to almost daily intercourse with the Emperor. The family of Menchikoff does not date from the early periods of the Russian aristocracy, but is, comparatively, of recent date. It was founded by a journeyman pastrycook, who cried his wares through the streets of Moscow, until he cried himself into the regard of Peter the Great, who made him one of his special favourites. This, however, did not prevent his being sent to Siberia by Peter II., grandson of that monarch, who, though he had had Menchikoff for his tutor, yielded to the Dolgoroucki family so far as to banish him, instead of marrying his daughter as he had desired. Of this ex-pastrycook, the late envoy to Constantinople is the fourth direct descendant.

The **Turks**, who constitute the military or dominant *cast* of the Ottoman Empire, were originally of Tartar descent; but the origin of the tribe to which they belong is enveloped in obscurity. The first notice of them in history is about the year 800, when, issuing from an obscure retreat, they obtained possession of a part of Armenia, called from them Turcomania. They afterwards gradually extended their power; but in the 13th century, being harassed in their new possessions by other Tartar tribes, they retreated to Asia Minor, which they had previously conquered. Their dominions, divided for some time into petty states, were united under Othman, who assumed the title of Sultan, and established his empire at Prusa, in Bithynia, about the year 1300. His successors, animated by a military spirit, and supported by enthusiastic followers, extended their conquests over the adjacent parts of Asia, Africa, and Europe. The succeeding reign was that of Bajazet I., a warrior renowned in their annals, but whose fame was forced to yield to the greater numbers or superior combinations of Tamerlane.

In 1453 Constantinople was taken by **Mahomet** II., which annihilated the Eastern empire.* He swore the destruction of Christianity. The Morea and the Islands were soon overrun; the southern part of Hungary fell subsequently into his possession; Moldavia and Wallachia were occupied; Poland threatened; and, on the whole, the Turkish arms at that period met with few checks of importance.

The period of Solyman "the magnificent," who was contemporary with Henry VIII. of England, Francis I. of France, and Charles V. of Spain, was the zenith of Turkish glory, and forms the most brilliant epoch of Ottoman history.

The naval battle of Lepanto, in 1570, in which the Turks were signally defeated by the Spaniards and Venetians, was the first fatal blow to Ottoman domination on the seas.

In the 17th century the Turkish forces committed great devastations in Europe. In 1683 they marched through Hungary, and ventured to lay siege to Vienna; but on the advance of Sobieski, they retreated with heavy loss. A long warfare ensued, in which the Turks were repeatedly defeated. This led, in 1698, to the treaty of Carlowitz, by which Transylvania was secured to Austria; while Podolia, with the Ukraine, was restored to Poland. They again engaged in war with Austria, in 1716 and 1717, were defeated in several battles, and concluded at Passarowitz a treaty so unsatisfactory to the Ottoman pride, as to cause the deposition of the reigning monarch.

Since the above period the Turks have experienced many reverses, having been worsted on the side of Persia by Kouli Khan, and subsequently in repeated wars by the Russians. Recent events have shown all the instability of their power in Europe. More than three-fourths of their subjects in that part of their empire are disaffected, and have only been waiting the opportunity to effect their emancipation, and which the present hostile attitude of Russia may afford them. In 1822 the Greeks effected their independence; and the Ottoman sovereignty over Wallachia, Moldavia, Servia, Albania, and other countries, chiefly Christian, since that period has been little more than nominal. The defeat of the Turks by Ibraham Pacha of Egypt, and the peace effected by Russia, are within the memory of all. In 1838, the Bulgarians—in 1840, the Bosnians—in 1841, the Bulgarians—in 1848-50, the Moldavians and Wallachians—and in 1853, the Montenegrins revolted against the Ottoman rule; and on the recent entrance of the Russians into Jassy, the municipal authorities sent a memorial to the Emperor, offering their entire devotion to his government. All these circumstances tend to reveal the disastrous internal condition of Turkey; and to show that her coming doom is written by the finger of destiny on the walls of time.

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* The Turks took Constantinople by assault on the 23rd of May, 1453.; and the first piece of ordnance ever cast was employed to breach the walls.

In Turkish history the most remarkable epoch of modern times is the destruction of the Janissaries, which took place in 1825, in consequence of their formidable resistance to every species of reform in military discipline. For ages they had formed the standing militia of the country. Their origin dated from the reign of Murad I., who established this body from the captives taken during the conquest of Albania, Bosnia, Servia, and Bulgaria. From their numbers and union they at length became formidable to the government, and repeatedly mutinied against their Sultans. They even dethroned Selim; and in the beginning of the reign of the late Sultan Mahmoud, they broke out, in consequence of attempted innovations in the discipline of the army, into a dreadful insurrection, which lasted three days. At last the Sultan having gained the co-operation of their Aga, resolved to abolish them. On their offering resistance to the orders of their government, a general and successful attack wâs made upon them, when 25,000 men are said to have perished, and the entire force was annihilated. The feelings which long pervaded, and still continue to pervade, the remnants of this scattered band, are admirably pourtrayed in the following

Song of the Janissaries.

Have they trod down the mighty?—By sea and by shore,
Will our name be a watchword and terror no more?
Has the eagle been hurl'd from his throne in the air?
Will the fox find a home in the grim lion's lair?
Have they trod down the mighty?—The victors who stood
Resistless when life was pour'd forth like a flood!
The awarders of empire! the mates of the brave!
The freemen who hallow'd the land of the slave!

Our name is a scorn, and our sabres are rust,
Our palace a sepulchre gory in dust—
But again shall its turrets gleam high in the air,
And again shall the flash of our sabres be there!

Again shall the name of our Aga be known—
A spell that o'ershadows the mosque and the throne;
Again shall our foeman grow pale when he hears
The tread and the shout of the fierce Janiziers!

For a time—for a time may the tyrant prevail,
But himself and his Pachas before us shall quail;
The fate that tore Selim in blood from the throne,
We have sworn, haughty monarch! shall yet be thine own.

The warriors of ages! who fought and who bled
With Osman and Amurath—the deathless though dead,
Are they destined to pass like the sunshine of spring?—
Their fame to the winds, and their neck to the string!

By the Prophet! the waves of the Euxine shall stop,
The stars from the concave like hailstones shall drop,
Ere the traitor and coward may hope to tread down
The tameless in soul—the undimm'd in renown.

We warn thee, stern despot! thy hour is at hand,
Thou hast sharpen'd the lance, thou hast kindled the brand;
We are gathering like tempests that gather by night.
Woe—woe to thee, King! when we burst in our might!

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Number of Schools in England and Wales.—According to a parliamentary return recently published, of the number of day schools and Sunday schools in England and Wales, it appears that in 1818 there were 19,230; in 1833, 38,971; and in 1851, 46,114; and that the number of day scholars in 1818 was 674,883; in 1833, 1,276,947; and in 1851, 2,144,377. The number of Sunday schools in 1818 was 5463, with 477,225 scholars; in 1833, 16,828, with 1,548,890 scholars; and in 1851, 23,498, with 2,407,409 scholars. The proportion of day scholars to the population was, in 1818, as 1 in 17·25; in 1833, as 1 in 11·27; and in 1851, as 1 in 8 36; and the proportion of Sunday scholars to the population was, in 1818, as 1 in 24·40; in 1833, as 1 in 9·28; and in 1851, as 1 in 7·45.

LESSONS IN FRENCH.

THE PRONOUN.

Of the repetition of Personal Nominative Pronouns of the first and second person singular and plural.—Whenever two or more verbs, having for their nominatives a pronoun of the first or second person, singular or plural, are in the same tense, both affirmative, and separated by the conjunction *and, et,* the personal nominative pronoun is repeated or not; as in, I love and admire him, *Je* l'aime et l'admire, *or,* Je l'aime et je l'admire. If the verbs are both negative, and separated by the conjunction *neither, ni,* the personal nominative pronoun is not repeated; as in, I neither love nor esteem her, *Je* ne l'aime *ni* ne l'estime. When the verbs are separated by the conjunction *or* (*ou*), alone, the pronoun may not be repeated; as in, Whether I love or detest her, what is it to you? Que *je* l'aime *ou* la déteste, qu'est ce que cela vous fait; *or,* Que *je* l'aime *ou je* la déteste, qu'est ce que cela vous fait? But if the conjunction *ou* is not used alone, the pronoun ought to be repeated; as in, Que *je* l'aime *ou que* je la déteste, qu'est-ce que cela vous fait? I do not know whether I love or hate her, Je ne sais si je l'aime *ou si je* la hais.

Whenever the verbs are not in the same tense, or the same form, if the first has an object which is not a personal pronoun, or if they are separated by any other conjunction but *and, or,* and *neither,* the personal nominative pronoun should be repeated; as in, I have just arrived, and will set out to-morrow, *Je viens* d'arriver, et *je repartirai* demain. You are young (person) and probably love glory (action), *Vous* êtes jeune, et probablement *vous* aimez la gloire. I extended my arms as to embrace the horizon, and I found but the emptiness of the atmosphere, *J'étendais les bras* comme pour embrasser l'horizon, et *je* ne saisissais que le vide des airs. You please everybody, because you have as much modesty as wit, *Vous* plaisez à tout le monde, *parceque vous* avez autant de modestie que d'esprit. I hate him, but I marry him because it is my father's wish, *Je* le hais, *mais je* l'épouse parceque c'est la volonté de mon père. When passing from the affirmative to the negative, the pronoun may not be repeated, but it should when passing from the negative to the affirmative; as in, I fear God, dear Abner, and have no other fear, *Je* crains Dieu, cher Abner, et n'ai pas d'autre crainte. You have no wings, and you wish to fly, *Tu* n'as point d'ailes, et *tu* veux voler.

The preceding rules are all applicable to the pronouns of the third person singular and plural, except in the following cases. Whenever the verbs are not in the same tense, the repetition of the nominative pronoun is facultative; as in, He arrived this morning, and will start again to-morrow, *Il est arrivé* ce matin, et *repartira* (or *il repartira*) demain. When several verbs following each other have different objects, the pronouns should be repeated whenever the object changes, except before the last, if it is preceded by the conjunction *and, et;* as in, He takes a hatchet, cuts down the mast, throws it into the sea, calls me by name, and invites me to follow him, *Il* prend une *hache, il* coupe le *mat, le* jette à la mer, *il m'*appelle par mon nom, et *m'*invite à le suivre. When plural verbs follow each other, and we wish to suppress the conjunction *and* before the last, so as to give more power to the meaning of the sentence, the pronouns should be repeated; as, Deceitful, cunning, hypocritical, dangerous, they flatter, caress, and surround with enticements, Fourbes, adroits, hypocrites, dangereux, *ils* flattent, *ils* caressent, *ils* environment de séductions.

The preceding rules are not absolute, but as foreigners are deprived of this instinctive feeling which a native has, and which tells him when he may with propriety follow this or that inspiration, they should have a guide, and by following these rules, they will always be enabled to write correctly.

Of Personal Pronouns used Objectively.—The English personal pronouns used objectively are the following:—*me, thee, him, her, it, us, you, them.* These pronouns are expressed in French in different ways, according to their being used as direct or indirect objects of the verbs. A pronoun or a noun is the direct object of a verb, whenever it can be used with that verb without the assistance of a preposition, and make sense with it. A pronoun or a noun is the indirect object of a verb, when it cannot be used with that verb without the help of a preposition so as to make sense with it.

Of Personal Pronouns used as direct Objects of a Verb.—Whenever personal pronouns are used as direct objects of a verb, in a sentence which is either affirmative, negative, or interrogative, they are placed before that verb in all its tenses, except the imperative mood used affirmatively, in which case they follow the verb in French as they do in English; and they are expressed as follows :—*me, me; thee, te; him, le; her, la; it, le* or *la; us, nous; you, vous; them, les;* as in, He sees me, he me sees, il *me* voit. I see thee, I thee see, je *te* vois. We see him, we him see, nous *le* voyons. You see her, you her see, vous *la* voyez. You see it (speaking of a book), you it see, vous *le* voyez. He sees it (speaking of a watch,) he it sees, il *la* voit. You see us, you us see, vous *nous* voyez. I see you, I you see, je *vous* vois. We see them (speaking of persons and things,) we them see, nous *les* voyons. The same English objective pronouns, when employed with a verb in the imperative mood used affirmatively, and then placed after that verb, are expressed in the following manner:—*me, moi; thee, toi; him, le; her, la; it, le* or *la; us, nous; you, vous; them, les;* as in, Love me, aimez-*moi.* Love it, aimez-*le* or *la.* Love thyself, aime-*toi.* Love us, aimez-*nous.* Love him, aimez-*le.* Love yourself, aimez-*vous.* Love her, aimez-*la.* Love them, aimez-*les,* (speaking of persons and things.)

By comparing these pronouns with those which precede them, it will be seen that the only difference between them is in the first and second person singular, the other being expressed by the same words in either case.

Whenever a verb governs, without a preposition, a pronoun and a noun united by the conjunction *et,* that verb should be preceded by a plural objective pronoun of the same person as the pronoun expressed in English, and followed by the noun and pronoun which it governs ; in which case this pronoun should be expressed by one of the following words:—*moi, toi, lui, elle, nous, vous, eux, elles;* as in, Your father knows me and my brother very well, Votre père *nous* connait très bien *mon frère* et *moi.* I hate them and all their friends, Je *les* hais *eux* et tous *leurs amis.* I blame you and your sister very much. Je *vous* blame beaucoup *vous* et *votre sœur.* But if the noun and pronoun were separated by the conjunctions *ou* or *ni,* the objective pronoun placed before the verb should be omitted; as in, I neither love him nor his father. Je n'aime *ni lui ni son père.* I will take you or your brother. J'emmènerai *votre frere ou vous.*

Of Personal Pronouns used as indirect Objects of a Verb.—Whenever a personal pronoun is used as the indirect object of a verb, the preposition governed by that verb is either the preposition *to, à,* or some other; these two cases should be examined separately; the pronoun being expressed in a different manner in each.

Of Personal Pronouns used as indirect Objects of a Verb governing the Preposition To, à. —When a personal pronoun is employed as the indirect object of a verb governing the preposition *to, a,* in a sentence which is either affirmative, negative, or interrogative, the general rule is, that the pronoun should still be placed before the verb in all tenses except in the imperative mood used affirmatively, the preposition to be omitted in French, and the pronouns rendered by —*to me, me; to thee, te; to him* and *to her, lui; to it, y; to us, nous; to you, vous; to them* (speaking of things,) *y; to them* (speaking of persons), *leur;* as follows:— You speak to me, you (to me) speak, vous *me* parlez. I speak to thee, I (to thee) speak, je *te* parle. You speak to him or to her, you (to him or to her) speak, vous *lui* parlez. You do not pay attention to it, you (to it) do not pay attention, vous *y* faites attention. He speaks to us, he (to us) speaks, il *nous* parle. I speak to you, I (to you) speak, je *vous* parle. You speak to them, you (to them) speak, vous *leur* parlez. You do not pay attention to them (speaking of things), you (to them) do not pay attention, vous n'*y* faites pas attention. The same English objective pronouns, when employed with a verb in the imperative mood used affirmatively, and then placed after that verb, are expressed in the following manner :—*to me, moi; to thee, toi; to him* and *to her, lui; to it, y; to us, nous; to you, vous; to them* (speaking of persons), *leur; to them* (speaking of things), *y;* as in, Speak (to me), parlez-*moi.* Speak (to him) *or* (to her), parlez-*lui.* Speak (to thyself), parle-*toi.* Pay attention (to it), faites-*y* attention. Speak (to us), parlez-*nous.* Speak (to yourself), parlez-*vous.* Speak (to them), parlez-

leur. Pay attention (to them), (speaking of things), faites-*y* attention.

By comparing these pronouns with those which go before the verb, it will be seen that they are expressed by the same words, except in the first and second person singular. To this general rule, which requires that personal objective pronouns governed by the preposition *to* should be placed before the verb, and the preposition omitted, there are three exceptions, which we will examine separately.

Of Reflected Verbs governing the Preposition To.—Whenever a verb is reflected in French, although it may not be so in English, and governs the preposition *to, a,* the preposition as well as the pronoun which it precedes, are both placed after that verb in all its tenses and moods, whether affirmative or negative, and expressed as follows: *to me, à moi; to thee, à toi; to him, à lui; to her, à elle; to us, à nous; to you, à vous; to them* (masculine), *à eux; to them* (feminine), *à elles.* [*To it* and *to them* (speaking of things), are, as in the preceding case, expressed by *y* placed before the verb]; as in, You trust me, you yourself trust to me, vous vous fiez *à moi.* I trust thee, I myself trust to thee, je me fie *a toi.* He trusts him, he himself trusts to him, il se fie *à lui.* He trusts ner, he himself trusts to her, il se fie *à elle.* I trust it, I myself to it trust, je m'*y* fie. You trust us, you yourself trust to us, vous vous fiez *à nous.* We trust you, we ourselves trust to you, nous nous fions à vous. They trust them, they themselves trust to them, ils se fient *à eux* (masc.) a elles (fem.) I trust them (speaking of things), I myself to them trust, je m'*y* fie.

Of Verbs which, being used in a certain signification, require the Preposition To *and the Pronoun which it governs to be placed after them.*—There are verbs and verbal expressions which, being used in a certain meaning, require the preposition *to* and the pronoun which it governs to be placed after them, and to be expressed as they are in the preceding chapter; they are the following:—

Penser, to think (meaning to have one's mind occupied about a person or thing); as in, I think of you, I think to you, Je *pense à vous.* But when *penser* signifies to have an opinion about a person or thing, it governs the preposition *of, de;* as in, What do you think of me? Que *pensez*-vous *de moi? Songer* and *rever* having the same meaning as *penser* in the first case, as in, I think of you from morning to night, Je *songe* or je *reve à vous* du matin au soir. But when *rever* and *songer* signify to *dream,* they both govern the preposition *of, de;* as in, I dreamed of you the whole night, J'*ai reve de vous* toute la nuit.

Venir, to come, used in its natural meaning, and implying an idea of motion of the body; as in, He came to me, and spoke to me in this way, Il *vint à moi,* et me parla en ces termes. But when *venir* is used metaphorically, not implying a motion of the body, the pronoun is placed before the verb; as in, An idea came to my mind, Il *me vint* une idée. *Aller,* to go, follows the same rule as *venir;* as in, I went to him and shook hands with him, *J'allai à lui,* et lui serrai la main. This dress does not fit you well, Cette robe ne *vous va* pas bien.

Etre, when signifying *to belong;* or implying an idea of right or duty; as in, This book belongs to me, Ce livre *est à moi.* It is time to play, *C'est à moi* à jouer. It is mine to command and yours to obey. *C'est à moi* de commander et *à vous* d'obéir.

There are other phrases subject to the same rule, as *En appeler,* to appeal to. *Avoir affaire,* to have business with. *Avoir recours,* to have recourse. *Prendre garde,* to mind; and *Faire attention,* to pay attention.

Of Verbs which, governing the Preposition To, *have for their objects more than one Pronoun, or a Pronoun and a Noun.*—When a verb governs more than one pronoun, or a pronoun and a noun, with the preposition *to,* the several pronouns, or the pronouns and the noun, should all be placed after the verb, and the preposition *to* repeated before each; as in, I speak to you and him, Je parle *à vous* et *à lui.* I spoke both to him and his father, J'ai parle *à lui* et *à son pere.*

Remarks on the four preceding chapters.—It happens very often in English that the preposition *to* is not expressed with the verb, when in fact that verb requires it; hence arises a great difficulty for foreigners, whether they should use the dative or the accusative case with those classes of verbs. In order to get over this difficulty, it must be remembered that in French a verb cannot stand in the same relation with two nouns or two pronouns, unless they are united by a conjunction; thus the following expressions, I *told* your *father* a good *story*, I will *pay* your *mother* a *visit*, or any other of the same kind, cannot be translated literally in French, because the two nouns *father* and *story* are used in the accusative case with the verb *to tell*, as well as *mother* and *visit* with the verb *to pay*, without being united by a conjunction. But by analyzing the sentence, it is always easy to discover before which of the two objects the preposition *to* should be placed; for if I ask, *What have you told?* the answer is, *A story. To whom? To your father. What have you paid? A visit. To whom? To your mother.* Therefore, in the following sentences, I told him a story. I paid her a visit, *him* and *her* stand for *toh im* and *to her*, and are expressed accordingly; Je *lui* ai dit une histoire, Je *lui* ai fait une visite, and not, Je *l'*ai dit une histoire, Je *l'*ai fait une visite. There are many cases, however, which an American or an Englishman will not so easily analyze as the preceding. Let us take the verb *to permit*, for instance; the genius of the English languge admits of the following expression, *To permit a person to do a thing.* This cannot be said in French, because *to permit* signifies *to give permission*, which requires the use of the preposition *to* after it; thus we should say in French, *To permit to a person to do a thing*; the following sentence, therefore, I permitted him to go to the theatre, should be expressed by, Je *lui* (to him) *permis* d'aller au théatre, and not, Je *le* (him) permis d'aller au théatre. We also say, *to permit a thing to a person*; therefore the following sentence, My physician allows me to eat fish, could be rendered by, Mon médecin me (to me) permet le poisson, or, Mon médecin me (to me) permet de manger du poisson.

We will now examine a few verbs which, presenting the same difficulty, can be properly used by English pupils, by reasoning by analogy, with the verb *to permit.*

To please signifies *to be agreeable*, which cannot dispense with the preposition *to* before its object; we should say, then, instead of, *You please me, you please to me, Vous me* (to me) *plaisez. To pardon* signifies *to grant pardon*, which requires *to* before a noun of person; we should say, then, instead of, *I pardon you, I grant pardon to you, Je vous* (to you) *pardonne*; but we also say in French, *To pardon a fault to a person.* Therefore the following expressions, I pardon him for having deceived me, I forgive you for your past crimes, should be rendered by, Je *lui* (to him) pardonne de m'avoir trompé, Je vous (to you) pardonne *vos crimes passés. To answer* signifies, *to make an answer to a person or a thing*; therefore, I answered him, to come immediately, I have answered your letter, should be expressed by, Je *lui* (to him) répondis de venir desuite, J'ai répondu à votre lettre.

REFORMATORY SCHOOLS.

Among the important resolutions adopted by the committee on Mr. Adderley's bill for the protection of criminal and destitute children, we observe the following, on the subject of general pauper education, in which, we feel assured, every philanthropic mind must feel deeply interested:—

The 4th resolution opens with the general proposition—That a great proportion of the criminal children of this country, especially those convicted of first offences, appear rather to require systematic education, care, and industrial occupation, than mere punishment.

A series of important resolutions then follows, from which we select the most important:—

"That the common gaols and houses of correction do not generally provide suitable means for the educational or corrective treatment of young children, who ought, when guilty of crime, to be treated in a manner different from the ordinary punishments of adult criminals.

"That reformatory schools should be established for the education and correction of children convicted of minor offences.

"That such reformatory schools should be founded and supported partially by local rates, and partially by contributions from the state, and that power should be given for raising the necessary amount of local rates.

"That power should be given to the government to contract with the managers of reformatory schools, founded and supported by voluntary contributions, for the care and maintenance of criminal children within such institutions.

"That, irrespectively of the high moral considerations which are involved in this subject, whatever may be the cost of such schools and establishments, they would be productive of great pecuniary saving, by the effect which they would have in diminishing the sources from which our criminal population is now constantly recruited, and thereby reducing the great cost of the administration of the criminal law.

"That the education given in workhouses, although improved of late, has not been sufficiently directed to industrial training, which the committee deem to be of especial value, as affording the best means of enabling children to provide for themselves the means of independent support upon leaving the workhouse.

"That it is essential for the future welfare of children in workhouses that such arrangements should be made as will prevent the possibility of their intermixing with the adult classes, to the moral detriment of the children.

"That from the expense attending the building of district schools, under 7 and 8 Vict., c. 101, but few unions have combined for the purpose of establishing such schools; but where such schools have been established, they have effected much good.

"That it is expedient that greater facilities should be given to the guardians of different unions to combine for the purpose of establishing such district schools, and that the Government should be empowered to assist the unions willing to establish them, by partially contributing to the expense of the building.

"That the ragged schools existing in England and Scotland, and recently introduced into Ireland, especially the ragged industrial feeding schools, at present supported by voluntary subscriptions, or, as in Glasgow, by local rates, have produced beneficial effects on the children of the most destitute classes of society inhabiting large towns.

"That voluntary contributions have been found inadequate to supply the number of such schools at present required in the metropolis, and other cities and towns; and therefore they should not be excluded from the aid of the national grant, under the distribution of the Committee of Council for Education, great care being necessary in framing the minutes applicable to this description of schools, so as not to fetter private exertions, or to exclude men eminently qualified to fill the laborious and difficult position of teachers by the requirement of too high an educational certificate.

"That in any legislation which may take place on the subjects referred to by this committee, especial attention should be paid to the industrial part of the education of criminal and destitute children."

THE GOVERNMENT EDUCATIONAL MEASURE.

The substance of the objections made to the Government bill for promoting education, by those who support the voluntary system, may be seen in the following resolution, passed in a public meeting lately held at Leeds:—"That this meeting warmly appreciates the value of education, and desires the universal education of the people; that it sees with satisfaction, on the evidence of Parliamentary returns, an extraordinary increase in the number both of day scholars and Sunday scholars since the year 1818, greatly exceeding the rate of increase of the population; that it regards the bill of Lord John Russell for promoting education in boroughs as not called for by any necessity, and as open to many serious objections; that the bill would burden the inhabitants of this borough with a school rate which might amount to nearly £11,000 a-year, although the number of day scholars in the borough actually exceeds the proportion required by the educational authorities; that it would introduce serious dissension on the questions of education and religion into municipal bodies; that it would degrade town councils, by making them mere clerks and tax-collectors for the Committee of Council on Education, as they would be excluded from any share in the management of the schools; that it would tax the inhabitants of corporate towns doubly—namely, by local rates for their own schools, and by general taxation for the schools of the rural districts; that it would give to the Government a dangerous increase of patronage, and a centralized control over the education of the people; and that it would tend to weaken the spirit of self-reliance and individual effort, the great source of England's prosperity and freedom.

PRACTICAL ESSAYS ON EDUCATION.

DUTIES OF THE TEACHER.—(*Continued.*)

No individual can be happy as a teacher of youth who is not prepared to devote the whole of his powers, both natural and acquired, to the performance of its important duties. Fellenberg demanded for this office "a vigilance that never sleeps, a perseverance that never tires." I am persuaded that nothing short of this will suffice.

How strange, then, is the delusion of those who rush towards the office as the Elysium of indolence! That such should be wretched and miserable in the employment is rather a source of gratification than of regret. Let them flee with all haste to some more congenial occupation, for here they will find no abiding place. The glorious motto of Luther, "Work on earth and rest in heaven," must also be the motto of every faithful schoolmaster; and he who is not prepared to act in this brave spirit had better leave the service to warmer hearts and nobler minds.

Samuel Taylor Coleridge knew something of the spirit that actuates a good teacher when he penned the following lines:—

"O'er wayward childhood wouldst thou hold firm rule,
And sun thee in the light of happy faces,
Love, Hope, and Patience, these must be thy graces,
And in thine own heart let them first keep school.
For as old Atlas on his broad neck places
Heaven's starry globe, and there sustains it, so
Do these upbear the little world below
Of education—Patience, Love, and Hope.

* * * * *

O part them never! If hope prostrate lie,
Love too will sink and die.
But Love is subtle, and doth proof derive
From her own life that Hope is yet alive;
And bending o'er, with soul-transfusing eyes,
And the soft murmurs of the mother dove,
Woos back the fleeting spirit, and half supplies;
Thus Love repays to Hope what Hope first gave to Love.
Yet haply there will come a weary day,
When overtasked at length
Both Love and Hope beneath the load give way.
There with a statue's smile, a statue's strength,
Stands the mute sister, Patience, nothing loath,
And both supporting, does the work of both.

I have already briefly stated that children should be governed to a great extent in the same way that men are, for men are but children of a larger growth. The mode advocated is, by the adaptation of plans to the fixed and uniform tendencies of human nature. At the same time it is fully allowed that the government of a school must necessarily be arbitrary in its character; it must be power, exercised by the will of one man according to circumstances of which he is the sole judge.

Now there are two ways of obtaining power of this description—one is by force, the other by moral means. Both are absolutely necessary in their places, according to the age and character of those who are the subjects of discipline.

As an infant cannot be reasoned with, Locke warmly commended the mother who whipped her baby eight times ere she subdued it; for had she stopped at the seventh act of correction her daughter would have been ruined. I may here also notice the opinion of Dr. Bryce, namely, that in early infancy pain has a moral as well as a physical effect—the effect which a blister has on the body, producing what is medically termed "counter-irritation." Thus the child's attention is drawn away by the present pain from the fretfulness which made it unhappy; its happiness is restored, and good is effected, by the withdrawing of its mind from a bad object.

But a child, when it has arrived at the age of ten or twelve years is a reasonable being, and therefore I am of opinion that Dr. Johnson was wrong in arguing that "school-boys can be governed only by fear; that no stated rules can ascertain the degrees of scholastic punishment, but that it must be enforced till it overpowers temptation, till stubbornness becomes flexible, and perverseness regular." It appears to me that Lord Mansfield proved himself a wiser man when he said, on a certain trial, "My Lords, severity is not the way to govern either boys or men."

Allow me, then, to suggest "a more excellent way." Putting aside, therefore, at least for the present, corporal punishment, let us see how moral means may be brought to bear in this very important service.

The very first thing that should be attended to in every school is "Heaven's first law"—order. This point—not less important to the comfort of the teacher, and to the communication of knowledge, than it is to the happiness and moral welfare of the child, must be gained at all hazards. It is a sad mistake to attend to instruction as the first needful thing. The love of order and punctuality ought to be awakened before the means of knowledge are increased; and this, not because intellectual instruction is of secondary importance, but because discipline is itself a principal means both of moral and literary improvement.

Every intelligent being is aware of the beauty of order when he finds himself surrounded by it, and children do so in nearly an equal degree as adults. A good teacher will know how to turn this task for arrangement to account. I will only add that whatever may, in other respects, be the talents of an instructor, if he cannot maintain good order, he is not a fit moral governor of the young.

The question then arises, how is order to be obtained? I reply, by letting it to be thoroughly understood that you are determined to have it. Good or bad arrangements, a well or ill-chosen system, will, of course, materially affect the degree of order which can be maintained, and will also make a wide difference in the ease or difficulty of gaining it. I am not now, however, speaking of systems, but of the kind of influence which must be exercised to make any system work quietly, regularly, and efficiently, and here nothing can be done without unbending inflexible determination on the part of the teacher. He must be an absolute monarch, and he must speak and act as a man "having authority."

But you must not be only the object of fear but of love. Law, not caprice, must rule in your schools.

In enforcing authority, especially over numbers, it is of the utmost consequence that due attention be paid to the tones of the voice. A horse soon perceives the timidity of a rider by the shaking of his legs; and no sooner does he become aware that fear influences the rider than he refuses to obey. Children, in like manner, instinctively discover, by the tones of the voice, when a teacher is unable to enforce obedience; and the moment that fatal discovery is made, he may bid farewell to his power over them. He may implore, or he may be imperious; his pupils will not be beneficially influenced by either. I need not say that what I refer to has nothing to do with what is commonly termed a good or bad voice; it is not a question of high or low notes, and still less of loudness and violent vociferation. It is only as an index to the mind, as indicating the determination within, that the tones of the voice become important; and this kind of demonstration may be conveyed as readily in a whisper as in a shout.

Dr. Priestley has the following passage on the necessity of enforcing from young persons an implicit submission to authority. "It is of great importance," he says, "that children and young persons be accustomed to submit, without difficulty and reluctance, to proper authority; by which is meant such authority as it is for their own good, and the good of society, that they should submit to; because that habit of ready submission, and the temper of mind which accompanies it, will be of unspeakable service to them, and to every society of which they shall be members through life. Now this can only be enforced by the parent or tutor absolutely insisting upon submission, without ever retracting what has once been threatened for an offence, unless some sufficient and manifest reason intervene. Mankind always yield to necessity; and when their situation is properly understood by them, they do it at once, and without pain. A child that finds it absolutely impossible for him to reach the moon will never stretch his hand towards it again. If he be shut up in a room, he will never think of pushing against the wall, because he never knew it gave way to him; but he will go to the door, and make repeated attempts to force his way out there, because he has known the door to open."

Let it be remembered, in all cases of delinquency, that "he who is sincerely sorry for his fault is almost innocent."

You will, then, bear in mind, that the first step you have to take, in moral as well as in intellectual education, is to establish your authority.

There never was a more absurd notion than that which is now popular in some quarters, that children may be brought to love duty without any intervention of arbitrary command. To what extent it may be possible to substitute explanations and reasons for commands, I do not wish to give an opinion; but this I am well assured of,—no good will be done, unless the child knows that authority is at hand, if reason should fail. I account that discipline is little worth which does not teach a child to submit to authority,—simply as authority. "There are frequently moments in the course of education, and even of life," says Mr. Woodbridge, "when the delay which reasoning demands would expose us to the danger which it is intended to avert, and where we must learn to yield to authority without a question."

Authority once established, obedience will be prompt, and very soon become habitual. No obedience, indeed, is worth the name unless it be prompt, habitual, and cheerful. A languid and dilatory yielding to repeated commands is nothing more than rank disobedience.

But it is not enough to assert for a time, even successfully, your claim to unqualified submission; authority must be maintained through a long course of years, under every diversity of circumstances, and with a frequent succession of new scholars.

Now this cannot be done by the mere exercise of the will of the teacher, however strong that may be. You must now, therefore, endeavour to ascertain by what means you can gain an habitual ascendancy over the minds of the young.

I will enumerate some directions, in relation to this subject, in my next paper.

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ON NATIONAL SCHOOLS AND SCHOOLMASTERS.

BY THE RT. HON. THE EARL OF DERBY.*

In early times the wisdom of our forefathers, according to their lights and to the requirements of their age, made great and liberal provision for the diffusion of such education as they could command. Throughout the length and breadth of the land, and chiefly for the humbler classes of the community, establishments were provided, under the control and direction of the national clergy, comprehending a vast amount of educational power, partaking all of the religious, and, in some degree, of the eleemosynary character, for the purpose of training up in the fear of God, and such literature as the time allowed, the children alike of the upper, the middle, and the lower classes. Through the medium of such institutions, though many of them have been perverted from their original purpose—through the medium of similar institutions in the universities—there is many an instance of persons in the humble walks of life, who, introduced into places and situations where they had an opportunity of obtaining the best ideas of science, and applying to them the virtues of self-denial and noble diligence, have found their rich reward in taking their place among the master-spirits of the age; a place due more especially to those who combine with genius indefatigable exertion and steady self-denial—who know that no great objects can be attained without sustained and persevering exertion, and who have sought earnestly to avail themselves of those advantages which the piety and wisdom of our forefathers have placed at their disposal. But those institutions were mostly suited to the purposes of an age in which education, properly speaking, was confined to those who were destined for the service of the Church, or the few who intended to devote themselves exclusively to literary studies.

For a considerable time after the Reformation, and even until a comparatively recent period, there were many who held that for the humbler classes of this country over-education was dangerous, and that all that was required was just so much in amount as would enable them to read without difficulty, or rather to spell out, a chapter in the Bible. During the last century all classes of the community had sunk into a state of lamentable apathy in respect to the discharge of those duties more especially which pertain to the education of the people. In those days the population of the rural districts was confined, in the absence of all facilities for communication, within the narrow space in which the circle of their daily labour bound them down. Successive generations were born, vegetated, and died in contented ignorance, little alleviated by the careless and apathetic discharge of a very small portion of the duties of the clerical office. But unhappily, as was sure to be the case, whilst men slept the enemy sowed tares, and in the country parishes infidelity and vice were the inevitable progeny of spiritual and intellectual darkness. But, further, there rose up a new element, beyond, perhaps, the controlling power even of a body more devoted to their duties than at that day—the parochial clergy of the Establishment. With the growth of our manufacturing and commercial system the great towns began to rise into importance, and a population was brought together, having many opportunities of comparing mind with mind, of discussing and of reasoning—shrewd, hard-headed, hard-working, intelligent workmen, anxious to put themselves forward in life, having outgrown the powers of the parochial system, and having consequently, in their ignorance of spiritual things, little desire except of obtaining for themselves and their children that amount of knowledge which they saw was essential, but a knowledge confined only to that which would advance them in the ordinary concerns of their daily life. There arose also in the towns an inferior class—a class labouring for their daily bread, or perhaps earning it in a less creditable manner, but having little forethought, and little care except for gratifying the selfish instincts and animal wants of our nature, and too prone to be led away by the vicious gratifications of sensuality, and fall into brutal excesses when an opportunity presented itself of indulging in them.

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* Being the substance of his lordship's address, on the late opening of the Oxford Diocesan School, for training parochial schoolmasters, at Cullam. The school presents a considerable pile of collegiate-looking buildings, planted on the crest of an eminence on the Oxford side of the Thames. It consists of a chapel and cloisters, a hall, a practising school, an attached residence for the principal, somewhat extensive domestic offices, spacious school and lecture-rooms, with a long range of dormitories above. The front forms an elongated range of fine elevation, with jutting gables and corners. The number of students to be accommodated is 130, of whom there are at present about fifty inmates of the establishment.

Against the evils of ignorance the country is roused and excited; but I doubt whether the country is equally sensible of a danger which I hold to be not less than that of brutal ignorance—I mean the danger of instructed and enlightened infidelity; and it is against both these that, if we would save our common country from the inevitable consequences of two such concurrent plagues—it is against these that the efforts are to be directed of all who know that the virtue and knowledge, as well as the morals of a people, are the surest safeguard of its welfare, and that without it no country can prosper, and no country, in the presence of God, can hope to prosper.

By whom is it that efforts are to be made to encounter these gigantic evils? How are we to apply ourselves to deal with that which, if not checked, if not controlled, if not remedied, must lead to consequences day by day more pernicious and more destructive? On whom does this duty devolve? It devolves on teachers; it devolves on all who have a human heart in their bosom, upon all who can feel for the welfare of their neighbours and their countrymen, who can feel for their distresses and calamities, and who feel, also, that there can be no distress and no calamity which should demand so much pity, which should call so loudly for aid as the combined evils of infidelity and ignorance.

No doubt, the universal demand for knowledge, the universal desire for instruction, has led to the formation of many establishments and many means of providing for the instruction of the middle classes. Popular lectures, mechanics' institutes, the various appliances for giving an easy high road to science; these are what many of them most desire, and the demand has procured and regulated the supply. But that for which there is not the same amount of demand, because, unhappily, in the operation of nature we least feel those of our wants which, addressing themselves to the moral and spiritual part of man, are the most difficult of supply—that for which there is not the same demand, and consequently not the same supply, is the provision of well-ordered moral and religious instruction.

I believe that there is a great portion of this country who are of opinion that no education is in itself desirable or valuable which does not combine religious with secular instruction. I am certain that upon that principle the great majority in Parliament are disposed to proceed. But among the various religious denominations into which this country is unhappily divided, this great difficulty arises, that religious education being necessarily coupled with secular, such religious education can only be most advantageous when it is applied through the medium of those whose religious principles coincide with those of the people whom they are to instruct. I must do the Protestant dissenters the justice to say that they were the first to point out the apathy of former times, and to stimulate public attention to the necessity of religious instruction; but I am proud to say, on behalf of the Church of which I am an attached member, that in reference to efforts for the promotion of united secular and religious education, they stand proudly preeminent, far above the proportion of their number and their means, far above the proportional efforts of any other body of Christians in this country.

If it be every man's interest to promote the religious education of the country, it is peculiarly the interest, the object, the bounden duty of those who are attached members of the Church of England, to do their utmost for the promotion of education in conjunction with the Church of which they are members, and to make the **Schoolmaster**, as he ought to be, the right hand of the clergyman, in instructing the community at large. But how is this to be done? We are awaking to a sense of our national responsibility; we are awaking to a sense of our difficulties and our shortcomings. In former times—I trust that feeling is passing away, though it unhappily is not extinct—a man unfitted for anything else was deemed by himself and his friends fitted for the *office of schoolmaster*. The broken-down tradesman, the man who by intemperance had ruined himself and his family, the man of feeble bodily health, the man who might become at any moment a burden upon the parish, was too apt to be voted by the rate-payers fit for the functions of a schoolmaster, if he was fit for nothing else.

I hope a different order of things is rising; and if we wish to do our work effectively, we must take care to provide the necessary instruments for the efficient performance of that work. The power of teaching is itself a thing which has to be learned. Many a person, who is possessed of the highest amount of science, and learning, and various knowledge, has not the facility of communicating to others the knowledge which he possesses, and would seek to impart to them. The business of teaching is, like all others, to be learned, to be studied, and to be taught, and it is for that purpose primarily and principally that this and various other institutions of this kind throughout the country have been established in the course of the last few years, not so much for the purpose of supplying the direct machinery of education, as for training up those who are to direct that education, and placing in the hands of the country at large a fitting instrument for performing that which is an important national trust.

In a schoolmaster we require something more than the means of conveying to others such knowledge as he himself possesses—we require that he should be a man—if he is in truth to be the right hand of the clergyman, and his assistant in diffusing religious knowledge among the people—who sets about his work with the full knowledge of its requirements, and enters into it heart and soul—who puts his hand to the plough with a determination of not turning back—who labours not merely for the emoluments which his profession will give him, but for the good which rightly directed energy will effect for his fellowmen—one who labours also for the higher and holier object of doing his duty, not merely in the society of his fellow-creatures, but before the face of that God to whom we are responsible for the exercise of our respective talents.

It is for the purpose of promoting the selection of men, so qualified and so prepared to go forth to their important work, that in various parts of this country, aided by the liberality of parliament, and still further aided by the liberal contributions of those who are impressed with the importance of this object—it is for this purpose that institutions have been founded, in order to send out a supply of schoolmasters, far inferior to the demand that might arise were there any posssibility of its receiving an adequate supply, but still continually increasing in number and efficiency. It is satisfactory to know that this energy, in augmenting those institutions and increasing the number of available teachers, will lead to an increase in the number wanted. The more schoolmasters are sent out, the larger will be the demand for them, and the more widely will the example of schoolmasters like these be distributed throughout the length and breadth of the land.

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"The eighth was August, being rich arrayed
In garment all of gold down to the ground;
Yet rode he not, but led a lovely maid
Forth by the lily hand, the which was crown'd
With ears of corn, and full her hand was found.
That was the righteous Virgin, which of old
Liv'd here on earth, and plenty made abound;
But after wrong was lov'd, and justice sold,
She left the unrighteous world, and was to
heaven intoll'd."

It is August! Seven months of this year are gone. How fleetly and silently does Time bear us along the swift-gliding stream of Life!

"Still he goes,
And goes, and goes, and doth not pass away;
He rises with the golden morning, calmly,
And with the moon at night."

He passes on unheeded, and while we dream of Life, and hope, and hope, he flies swiftly past, and leaves us gazing with mute astonishment at the track behind him.

Let us remember that as grains of sand make a mountain, so moments make the year.

"Time never bears such moments on his wing,
As when he flies too swiftly to be marked."

He calls upon us, and says, with earnestness and truth,

"Redeem mine hours—the space is brief—
While in my glass the sand-grains shiver,
And measureless thy joy or grief
When 'Time and thou shalt part for ever!'"

August is said to have derived its name from the Roman Emperor, Augustus Cæsar, to whom it was dedicated in honour of his being created Consul in this month, and having triumphed three times in Rome, subjected Egypt to the Roman power, and put an end to Civil Wars. It was called *Sextilis,* or the sixth month in the Album Calendar, in which it had only twenty-eight days assigned to it. Romulus added two days, and Augustus Cæsar a third, which number it has since retained; and from the time that Numa Pompilius revised the Calendar, it has continued as the eighth month of the year.

The Anglo-Saxons called it *Arn monat,* or *Barn monath,* alluding to this being the period when their barns were commonly filled; the Saxon word *Arn* signifying harvest. It was also called *Weod monath,* clothing month, alluding to their fields being then clothed with corn, just as the Romans dedicated this month to Ceres, the goddess of harvest.

The synonymes of the month are as follows: in Latin, *Augustus;* French, *Août;* Italian and Portuguese, *Agosto.*

The allegorical representation of the month is a young man of rustic and cheerful countenance, with a flame-coloured habit; upon his head was a garland of rye and wheat; upon his arm a basket of ripe fruits; at his belt a sickle; and at his side the sign *Virgo,* the Virgin, because the sun enters that constellation on the 23rd of the month.

We now turn from the consideration of the etymology of August to its chronology.

CALENDAR FOR THE MONTH.

1. *Lammas-day.*—R. Savage died 1743.
2. Gainsborough died 1788.
3. Sir R. Arkwright died 1792.
4. Calais taken by Edward III. 1347.
5. Fenelon born 1651.
6. *Transfiguration.*—Ben Jonson died 1637.
7. *Name of Jesus.*—Bacon, the sculptor, died 1799.
8. G. Canning died 1827.
9. John Dryden born 1631.
10. *St. Lawrence.* — Greenwich Observatory founded 1675.
11. Dr. Meade born 1673.—Dog days end.
12. *Grouse-shooting begins.*—Hufeland born 1762
13. *Old Lammas-day.*—Jeremy Taylor died 1667.
14. George Colman died 1794.
15. *The Assumption of the Virgin.*—Napoleon born 1769.—Sir Walter Scott born 1771.
16. Andrew Marvell died 1678.
17. Frederick the Great died 1786. — Madame Dacier died 1720.
18. James Beattie died 1803.
19. Royal George sunk off Spithead 1782.
20. Dr. Maginn died 1842.
21. Lady M. W. Montague died 1762.
22. Dr. Gall died 1828.
23. Sir William Herschel died 1822.
24. *St. Bartholomew's Day.*—Massacre at Paris 1572.
25. Battle of Cressy 1346.—James Watt died 1819.
26. Prince Albert born 1819.
27. James Thomson, the poet, died 1748.
28. *St. Augustine.*—Admiral Blake died 1658.
29. *St. John the Baptist beheaded.*
30. W. Paley born 1743.
31. J. Bunyan died 1688.

The Red Letter Days of the Month demand some little consideration. The reason these Saints' days, fixed festivals, &c., are termed red letter days, is said to be in consequence of the old almanacks distinguishing the days by printing them in red ink, which method was copied from the monks illuminating those days in their calendars with red. They are held on the following days:

1*st.*—The first of these is *Lammas Day,* which is a fixed festival, but not observed by the Church of England, and is now only remarkable as a day of term for some purposes. Brand tells us that "antiquaries are divided in their opinions concerning the origin of Lammas Day; some derive it from Lamb-Mass, because on that day the tenants who held lands under the Cathedral Church in York, which is dedicated to St. Peter ad Vincula, were bound by their tenure to bring a live lamb into the church at high mass; others derive it from a supposed offering or tything of lambs at this time." Various other derivations have been put forth from time to time. Blount says, that Lammas was called in Saxon *Hlaf-Mass* (loaf mass, or the loaf festival), the *f* being in time softened away, on account of the difficulty of pronouncing it before the *m.* Vallancey informs us that in Ireland this day is dedicated to the sacrifice of the fruits of the soil, and that *La-ith-mas,* the day of the obligation of the grain, is pronounced *Lee-Mas*, which by corruption has become Lammas.

Lammas seems to have been held as a day of thanksgiving for the new fruits of the earth. It was observed with bread of new wheat, which is called Lammas wheat; and there was a custom in some places, at no distant period, for tenants to be bound to bring in wheat of the new crop to their lord on or before this day. It was probably one of the great festival days of our heathen ancestors; and it is worthy of observation that it occurs exactly three months after another of these — Beltane. Cormace, Bishop of Cashel in the tenth century, records that in his time four great fires were lighted up on the four great festivals of the Druids—namely, in February, May, August, and November; probably Beltane and Lammas were two of these.

The first day of August is called the "Gule of August," probably from the Celtic *Cul* or *Gul*, which signifies a festival. Gebelin says, that as the month of August was the first in the Egyptian year, it was called *Gule*, which, being Latinized, makes *Gula* (a throat); and antiquaries have been pleased to institute a festival to St. Peter ad Vincula upon this day, when the people of England formerly paid what was termed their Peter-pence.

6*th.*—The next festival is "*The Transfiguration of our Lord*," which is not observed by the Church of England, although inserted in the calendar attached to the Prayer-Book. It was instituted by Pope Calixtus, in commemoration of Christ's Transfiguration on the Mount.

7*th.*—"*The Name of Jesus*," which is a festival of the primitive Roman Church; first dedicated to St. Afra, and afterwards to St. Donatus, whose name was expunged by the English Reformers to make room for the present festival.

10*th.*—"*St. Lawrence.*"—This is a festival held in honour of this Saint, who suffered martyrdom at Rome, by order of the Emperor Valerian. It is said that the order for his punishment—being roasted alive—ran thus: "Bring out the grate of iron; and when it is *red hot, on* with him, *roast him, broil him, turn him; upon pain of our high displeasure, do every man his office, O ye tormentors.*" He is the tutelary Saint of the Spaniards; and the church of the Escurial in Spain, founded by Philip II., and dedicated to St. Lorenzo, in honour of Philip having won a battle upon the 10th of August, is built in the form of a gridiron, which is supposed to have been the instrument of torture employed by the Emperor Valerian.

15*th.*—"*The Assumption of the Virgin.*"—This is a grand festival of the Romish Church. It was instituted in 813, to celebrate the ascension of the Virgin into heaven. In Catholic countries this day is marked by splendid ceremonies and processions.

24*th.*—*St. Bartholomew's Day* is a festival of the Church of England. St. Bartholomew was an apostle, but there is no scriptural account of his labours or death. The legend of the Romish Church represents him as preaching in the Indies, and concluding his life by being flayed alive by order of Astyages, brother to Palemon, the king of Armenia. In memory of his death it was customary at our monastic institutions, in the middle ages, to distribute small knives amongst the people; and this practice was continued at Croyland Abbey until the time of Edward IV. Many of these knives have been found in the river and the ruins of the Abbey. The day has a horrible celebrity in connection with the massacre of the Protestants at Paris in 1572, when 10,000 were butchered in a fortnight, besides 90,000 in the provinces.

28*th.*—"*St. Augustine's Day.*"—This saint was born at Tagosta, in Numidia, in 354.

29*th.*—"*St. John the Baptist beheaded.*"—This festival is held in honour of the decollation of St. John, by order of Herod, when Salome, the daughter of Herodias danced before him.

August possesses charms even for the gastronomist: for upon the 5th of the month the oyster season begins—*an opening day* for the London fishmongers. The consumption of oysters in London alone is estimated at about 14,000 or 15,000 bushels a-year; and the imports between 52,000 and 54,000 bushels a-year. Suppose, then, as so many of these animals are daily consumed during this month, we have a chat about the oyster.

The common oyster (*Ostrea edulis*, Div. 2, *Mollusca*; Class 4, *Acephala*; Ord. 1, *Testaceæ*, Cuvier), is found in most parts of the British coasts; but those from Essex and Suffolk are held in greater esteem. The Purfleet, Colchester, and Milford are excellent; but the white, fleshy native Milton, are the best. The Colchester oysters come into the market this month; but the Milton do not arrive until October; however, Christmas is the best time for them.

Oysters are hermaphrodites, and, at the proper time (about April or May), they throw out their spawn, or *spats*, as they are termed by the fishermen. These spats are deposited upon the rocks, or some other hard substance, to which they adhere. It is natural to suppose that much of the excellence of the oyster depends upon the nature of the soil of the bed and the water in which they live. In Scotland, those oysters that are laid down in beds near the salt works possess a fine rich flavour, and acquire a great size. If laid down upon rocky ground they become thick and solid; beds of marle make them glutinous; slimy beds render them oily and luscious; and chalky beds make the shells friable and their inmates poor. Those persons who breed oysters on a large scale pay great attention to these points, so as to suit the tastes of their various customers.

When the oysters have arrived at their full size, or are sufficiently grown to send to market, they are removed from their beds by dredges, drawn over them by a rope. They are then laid in pits or stores (with their *flat sides uppermost*), which are so constructed that the water is let in and out once or twice a day. At the end of about six weeks they are fit to pack in barrels, or send to the market in large quantities.

Oysters respire by means of brancheæ or gills. They draw in the water at the mouth (which is a small opening in the upper part of the body) for the purpose of respiration; and they drive it down a long canal that forms the base of the gills, and so out again (at the orifice), retaining the air for the purpose of performing the necessary functions of the body. Leeuwenhoeck, the microscopist, discovered immense numbers of small oysters, with their shells perfectly formed, swimming about in the fluid of the full-grown oyster. He estimated that each perfect oyster contained from 3,000 to 4,000 of these embryos, besides animalculæ, 500 times less than them in size. Following out his calculation, he arrived at the conclusion that a sphere, whose diameter was an inch, would, if the oysters were globular, be equal to 1,728,000 of them.

How few persons that eat oysters ever consider for a moment anything about them, further than their flavour! Yet there is much to instruct us even in the humble oyster; and did space permit, we might continue the subject, by giving the history of the oyster, its introduction into gastronomic circles, anecdotes of its virtues and faults, and finally sum up the whole by a series of receipts for cooking it in perfection.

The sportsman looks forward with pleasure to the twelfth of the month, when grouse-shooting commences. Then he hies to the moor with friend and dogs, and searches for the much-coveted game. The common grouse, or moor fowl (*Tetrao tetrix*), are only found in sequestered places, abounding with copses and brushwood, confining themselves wholly to the open moors and uncultivated wastes covered with heath, in which they build their nests of a few dried stalks, and lay about eight eggs. They delight in the borders of streams and marshes, feeding in autumn upon wild berries and seeds, and in winter upon the buds of trees, insects, and worms. The black cock is a fine bird, often weighing three or even four pounds. The general appearance of the male bird is black, with rich tints of purple, dark green, and blue, about the neck feather; and the colour of the female is brown, mottled with black, particularly on the back, where the colouring is deeper than on any other part.

Let us hasten into the fields to witness the golden-eared corn. Behold!

> "The reapers now their shining sickles bear,
> A band illustrious, and the sons of health!
> They bend, they toil across the wide champaign;
> Before them Ceres yields her flowing wealth."

Sheaves of wheat are being piled upon the carts, and the whole field is astir. Children with ruddy faces are *leasing* or gleaning the corn that falls from the shearers and carts, exactly the same as Ruth did more than three thousand years ago. It is a privilege the poor always enjoy, and a pleasant sight it is. See how happy the children look that are bearing the fruits of their day's labour home to their parents. One little fellow can scarcely toddle under the load he has in his frock. But here comes the Harvest Queen, with her merry retinue of lads and lasses, escorting the last load of corn, or "*horkey* load," decorated with flags and streamers. The following lines of Herrick aptly describe the scene. For

> "About the cart heare how the rout
> Of rural younglings raise the shout;
> Pressing before, some coming after,
> Those with a shout, and these with laughter.
> Some blesse the cart; some kiss the sheaves;
> Some prank them up with oaken leaves;
> Some crosse the fill-horse; some with great
> Devotion stroak the home-borne wheat."

How pretty the Harvest Queen looks with her corn wreath, and gay streamers! How every face beams with joy, anticipating a merry evening after their day's labour. Hark! they are singing the last verse of a

HARVEST SONG.

Now harvest is over
We'll make a great noise.
Our master, he says,
You are welcome, brave boys;
We'll broach the old beer,
And we'll knock along,
And we will sing an old harvest song.

They will soon be busily engaged with a good supper, after which the Harvest Queen and her rustic throng will dance with "free and airy steps" over the well-swept floor of the barn.

The shadows of night are fast retreating before the golden sunbeams; the chirping birds announce the return of morn, and o'er the dewy garment of Nature a thousand beauteous plants unfold their petals, diffusing their perfumes through the freshening breezes. Awake! and rejoice that you have lived to see another day, and that promises repose, harmony, and peace.

Let us hasten abroad, for

> "The morning is the season of delight—
> The morning is the self-possessioned hour—
> 'Tis then that feelings, sunk, but unsubdued,
> Feelings of purer thoughts, and happier days,
> Awake, and, like the sceptred images
> Of Banquo's mirror, in succession pass."

We shall find a great variety of floral beauties in the gardens and the fields; the chief of these are as follows:—

Garden Flowers.—Passion flower (*Passiflora cœrulea*); shining marigold (*Tagetes lucida*); French marigold (*T. patula*); the garden hydrangea (*Hydrangea hortensia*); the yellow gentian (*Gentiana lutea*); the globe thistle (*Echinops sphærocephalus*); the sunflower (*Helianthus annuus*), which was originally brought from Peru, and is used as an emblem of false riches; several varieties of dahlias, among which the tree dahlia (*Dahlia excelsa*), from Mexico, the scarlet dahlia (*D. coccinea*), and the rugged variety (*D. frustranea*), are most conspicuous. We shall also find other plants in flower, such as the tansy (*Tanacetum vulgare*); calceolarias (*Calceolaria integrifolia*, &c.), of all kinds; the American trumpet tree (*Catalpa syringifolia*); the purple thorn apple (*Datura metel*); the rudbeckia (*Rudbeckia purpurea*); the sweet-scented golden rod (*Solidago odora et gigantea*); the calathian violet (*Gentiana Pneumonanthe*); the sweet sultan (*Centauria moschata*); and the turnsole (*Heliotropium Europæum*). If we go into the fields,

> "Where press the scabions[*] and the campion
> pale,"[†]

there is much to interest us, particularly

The Wild Plants of the Month.—These may be seen in the woods, hedge-rows, and commons, but are not very numerous, yet are nevertheless of sufficient interest to entice the botanist to take a ramble. Perhaps the most conspicuous and commonly seen is the camomile flower, of which there are several kinds—viz., the medicinal variety (*Anthemis nobilis*), is used for fomentations, and in the form of decoction or infusion as a tonic; then we may see the ox-eye camomile (*A. tinctoria*), with its large yellow flowers; the stinking camomile (*A. cotula*), which blisters the hands in gathering it; the tall variety (*A. altissima*); the saw-leaved (*A. discoidea*); the dotted (*A. punctata*), and the parsley-leaved (*A. apiifolia*) varieties. There is the grass of Parnassus (*Parnassia palustris*); the wild mignonette (*Reseda luteola*), from which the pigment called Dutch pink is obtained. And

> "The scarlet pimpernet[‡] creeps here and there;
> Amid the corn the crimson poppies blush;[§]
> Still on the brooks gleam water-lilies[||] rare,
> And purple loosestrife[¶] and the flowering
> rush."[**]

The common cudweed (*Guaphalium Germanicum*); the corn spurrey (*Spergula*

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[*] *Juncus obtusiflorus.*
[†] *Cucubalus baccifer.*
[‡] *Anagallis arvensis.*
[§] *Papaver rhœas.*
[||] *Nymphæa cœrulea.*
[¶] *Lysimachia dubia.*
[**] *Scabiosa succisa.*

arvensis), which is such an eyesore to the farmers; and the sun-sparge (*Euphorbia helioscopia*), are found in our corn-fields. Then we may find the field-southernwood (*Artemisia campestris*), which delights in a sandy soil; and

> "The blue campanula,[*] and chicory wild,[†]
> And yellow toad-flax,[‡] variegate the plain."

The tall hemp agrimony (*Eupatorium cannabium*), with its pale flesh-coloured flowers grouped in clusters, growing by the river's side; and if perchance the stream had a flowery bank, where

> "True love lies bleeding,[§] with the heart at ease,"[‖]

we may also find the elecampane (*Inula helenium*), which we remember purchasing, in our younger days, from the confectioners; and the fuller's teasel (*Dipsacus fullonum*), which is used to raise the nap from woollen cloths, the teasels being fixed in the circumference of a large wheel, so that when it revolves the teasels pass over the surface of the cloth; and if a knot catches these vegetable brushes, they immediately break, and do not injure the fabric like any mechanical invention. Few persons consider the uses to which the humblest flowers which surround them may be applied; but we should all remember that everything has its use, and that all were created to fulfil some office, however humble.

Among the birds of the month we observe the sanderling (*Calidris arenaria*); the crossbeak (*Loxia curvirostra*); the aberdevine (*Carduelis spinus*); and the knot (*Tringa cinerea*), which arrive from northern climates. Like the fashionables in a great town, some arrive and others depart; so it is with the birds; for we find that many are now leaving for more southern latitudes; for example, the lapwing (*Vanellus cristatus*); the wryneck (*Yunx torquilla*); the cuckoo (*Cuculus canorus*); the swift (*Cypselus murarius*); the puffin (*Fratercula arctica*); the dottrel (*Charadrius morissellus*), and other species.

The fisherman has not much to amuse him during the month, for the tench (*Tinca communis*) spawns; and little else but the carp (*Cyprinus carpis*), the trout (*Salmo fario*), and the minnord (*Leuciscus phoxinus*), remain to gratify his sporting propensities.

The present month is not very rich in entomological specimens; however we may collect the zigzag moth (*Notodonta ziczac*); the goose-egg moth (*Cilix compressa*); the brown-tail moth (*Porthesia auriflua*); the brown hair-streak butterfly (*Thecla betulæ*), and the painted-lady butterfly (*Cynthia cardui*).

The quadrupeds of the month are the harvest mouse (*Mus messorius*); the field mouse (*M. sylvaticus*); and the shrew mouse (*Sorex fodiens*).

The reptiles are the toad; the frog (*Rana temporaria*); and the natterjack (*Bufo rubeta*).

SALE OF RARE MANUSCRIPTS AND BOOKS.

At the late sale of the Rev. D. Hawtrey's manuscripts and books, there were many curious specimens which sold at rather unusual prices. Among others, "The Olde and New Testamente, from the Douche and and Latyn," 1535, known as "Coverdale's Bible," sold for £111; "The Works of Dante," a MS. of the 14th century, 170 leaves, with drawings in colours representing the torments of the damned, for £105; "The Bible in French," a MS. of the 15th century, with paintings, and ornamented, £86; "Evangelistarium Latine," a MS. of the 8th century, 119 leaves, £57; "Homer's Works in Greek," 1488, once the property of Colbert, £70; "The Booke of Common Prayere," black letter, 1549, £41; "Petrarch's Works," a MS. of 15th century, £44; "A Virginian Bible," being the only book printed in the language of the Indians of Virginia, a race now extinct, date 1685, £22; "Poems on Persian History," a MS. in Persian, dated in the 949th year of the Hegira, from the library of the King of Oude, £22; "Shakspeare's Works," from the original manuscript, folio, 1623, £63; "A Missal," date 1555, £26; "Cicero's Works," a MS. of the fourteenth century, £28; "A Bible," date 1557, with autograph notes by, and once belonging to, Melancthon, £22; "Exodus, in Hebrew," printed on vellum at Constantinople, A.M. 5305, £17; "The Works of Dante," first edition, folio, 1472, £43; Ovid's "Metamorphoses," an Italian MS. of the 15th century, £90.

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[*] *Campanula azurea.*

[†] *Cichorium intybus.*

[‡] *Linaria vulgaris.*

[§] *Amaranthus caudatus.*

[‖] *Viola tricolor.*

THE EDITOR AND HIS CORRESPONDENTS.

College of Preceptors. Adolescens.—The college has now been in existence for seven years, and was incorporated by royal charter in 1849, It is situated in Bloomsbury Square, and the Rev. Dr. Jacob, Head Master of Christ's Hospital, is the respected President. Its objects are to raise the standard of abilities and attainments of tutors, so that the scholastic profession "shall have its recognized position in the same way as the clerical, legal, and medical professions." In accordance with these objects, the college have put forth the following "propositions:"—That the great body of schoolmasters and teachers in this country will never attain to an adequate degree of efficiency, and that education itself will never reach its proper standard amongst the middle classes as long as the profession shall be open to uncertificated persons. —That middle class teachers, though now formed by royal charter into a liberal profession, have still no power to exclude incompetent persons, or to protect the public against the injurious effects arising from their false pretensions.—That if the principle of compulsory examination, as avowed by the College of Preceptors, were once recognised by the Lord President and Committee of Privy Council on Education, as binding upon all professional teachers, such recognition would tend powerfully to strengthen the hands of this corporation, and generally benefit education throughout the whole of the British empire.—In the general report, which was read at the last half-yearly meeting, we find a statement that the council, in March last, with a view of carrying the above objects into effect, placed themselves in communication with the Lords of the Committee of Privy Council on Education, and addressed to their Lordships a general memorial, in which they state that the said college has well established and regularly held half-yearly sessions for the examination of teachers; and that at the thirteen sessions now elapsed, three hundred teachers have been rigidly examined, and about a thousand certificates of the several degrees of fitness to teach have been carefully awarded. The memorialists then proceed to state that, as a portion of the funds at the disposal of the committee for educational purposes might be legitimately awarded in aid of the objects of this institution, and that great benefit would accrue to it and to the public from so high a recognition of their efforts, they respectfully and earnestly beg to press the propriety and wisdom of an annual grant for the purposes stated, as well as for other charges essential to the support of a board of examiners and the due application of the charter, &c. The result of this application is yet to be seen.

Is the Caterpillar an Insect? J. H. Wood.—*Insecta* is the name applied by Linnæus to a most extensive class of animals, thus designated from their being *cut* or divided into numerous parts or segments. The term is equally applicable to various species which have the chief divisions of the body connected together by slender points of attachment; the legs being in like manner inserted or composed of various articulations. With these characteristics, which apply generally to the insect family, the caterpillar corresponds; this being the common name by which the larvæ of lepidopterous insects are known. Even when the caterpillar assumes the form of a moth, or butterfly, it still remains an insect, belonging to the order *Lepidopteræ*, and corresponding with the great division *Diurnæ* of Latreille, or the Linnæan genus *Papilio.*

Mental Arithmetic. F. C. Byers.—There are several works Published on Mental Arithmetic, containing "short methods of calculation, which are adapted to business purposes;" such as Dr. Wilcock's "Arithmetical Calculations," or the "Manuals of Mental Arithmetic," by Felton, Harrison, or Hopkins, any of which may be studied with advantage. A knowledge of the "extended multiplication table up to twenty" is hardly worth the attainment. It has only a tendency to cause that confusion of which you complain—especially as the numbers from 13 to 19 inclusive can be used as multipliers in one line with so much facility by merely adding the unit figure to the tens place, the tens figure to the hundreds place, and so on.

Book-keeping. P. S. W.—Several excellent works have been lately published; but the one issued by Messrs. Chambers, in their Educational Course, can be safely recommended for its clearness and simplicity, and, above all, for its cheapness. Our correspondent's question respecting the proposed calculations in compound interest can readily be solved by a little labour. There are no published tables that would answer his purpose.

Simple Microscopes. T.—The magnifying power of a simple microscope is in proportion to the shortness of its focal strength. Thus a lens of 2 inches focal distance, magnifies 5 diameters (or the superficies 25 times)—of 1 inch focus, 10 diameters—¾ths of an inch, 15 diameters—½ inch, 20 diameters—¼ inch, 40 diameters—⅛th inch, 80 diameters—1-10th inch, 100 diameters. This table of magnifying powers is not invariably correct, owing to the difference of vision in different individuals, but it is sufficient for all practical purposes.

NATURAL PHILOSOPHY.

Second Division.

PROPERTIES OF LIGHT.—Optics.

CHAPTER XXXIX.

OF COLOURED LIGHT.

Action of the Prism—Refraction and Dispersion—The Solar Spectrum—Its Constituent Rays—They pre-exist in White Light—Theory of the Different Refrangibility of the Rays of Light—Different Dispersive Powers—Irrationality of Dispersion—Illuminating Effects—The Fixed Lines—Calorific Effects—Chemical Effects.

In speaking of the action of a prism, in Chapter XXXVII., it was observed that it gives rise to many interesting results connected with coloured lights. These, which constitute one of the most splendid discoveries of Newton, I next proceed to explain.

Through an aperture, *a*, Fig. 240, in the shutter of a dark room let a beam of light, *a e*, enter, and let it be intercepted at some part of its course by a glass prism, seen endwise, *b c*. The light will undergo refraction, and in consequence of what has been already stated, will pass in a direction, *d*, toward the back of the prism. Now, for anything that has yet been said, it might appear that this refracted ray, on reaching the screen *d e*, would form upon it a white spot similar to that which it would have given at *e*, had not the prism intervened. But when the experiment is made, instead of the light going as a single pencil of uniform width, it spreads out into a fan shape, as is indicated by the dotted lines, and forms on the screen an oblong image of the most splendid colours. In this beautiful result, two facts, which are wholly distinct, must be remarked:—1st, the light is *refracted* or bent out of its rectilinear path; 2nd, it is *dispersed* into an oblong coloured figure.

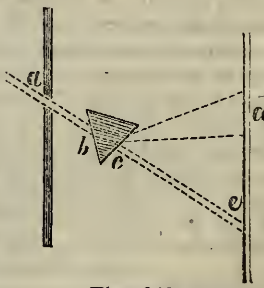

Fig. 240.

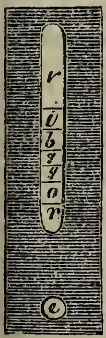

Fig. 241.

On examining this figure or image, which passes under the name of the solar spectrum, we find it divided into seven well-marked regions. Its lowest portion, that is to say, the part nearest to that to which the light would have gone had not the prism intervened, is of a red colour, the most distant is of a violet, and between these other colours may be seen occurring in the following order:—red, orange, yellow, green, blue, indigo, violet.

In Fig. 241, the order in which they occur is indicated by their initial letters, *e* being the point to which the light would have gone had not the prism intervened.

Now from what source do these splendid colours come? Newton proved that they pre-existed in the white light, which, in reality, is made up of them all taken in proper proportions.

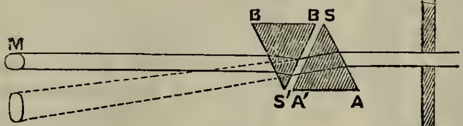

Fig. 242.

There are many ways in which this important truth can be established. Thus, if we take a second prism, B B′ S′, Fig. 242, and put it in an inverted position, as respects the first, A A′ S; so that it shall refract again in the opposite direction the rays refracted by the first, they will, after this second refraction, reunite and form a uniform beam, M, of white light, in all respects like the original beam itself.

If the production of colour were due to any irregular action of the faces of the first prism, the introduction of two more faces in the second prism would only tend to increase the colouration. But so far from this, no sooner is this second prism introduced than the rays reunite and recompose white light. It follows as an inevitable consequence that *white light contains all the seven rays.*

But Newton was not satisfied with this. He further collected the prismatic coloured rays together into one focus by means of a lens, and found that they produced a spot of dazzling whiteness. And when he took seven powders, of colours corresponding to the prismatic rays, and ground them intimately together in a mortar, he found that the resulting powder had a whitish aspect; or if, on the surface of a wheel which could be made to spin round very fast on its axis, coloured spaces were painted, when the wheel was made to turn so that the eye could no longer distinguish the separate tints, the whole assumed a whitish-gray appearance.

By many experiments Newton proved that the true cause of this development of brilliant colours from a ray of white light by the prism, is due to the fact that that instrument does not refract all the colours alike. Thus it could be completely shown, in the case of any transparent medium, that the violet ray was far more refrangible than the red, or more disturbed by such a medium from its course. In this originated the doctrine of "the different refrangibility of the rays of light."

On examining the order of colours in the spectrum, we find, in reality, as in Fig. 241, that the red is least disturbed from its course, and the other colours follow in a fixed order. The red, therefore, is spoken of as the least refrangible ray, the violet as the most, and the other colours as intermediately refrangible.

We now see the cause of the development of these colours from white light, which contains them all. If the prism acted on every ray alike, it would merely produce a white spot at *d*, analogous to that at *e*, Fig. 241; but as it acts unequally it separates the coloured rays from one another, and gives rise to the spectrum.

On examining prisms of different transparent media, we find that they act very differently—some dispersing the rays far more powerfully than others, and giving rise, under the same circumstances, to spectra of very different lengths. In the treatises on optics, tables of the dispersive powers of different transparent bodies are given; thus it appears that oil of cassia is more dispersive than rock-salt, rock-salt more than water, and water more than fluor spar.

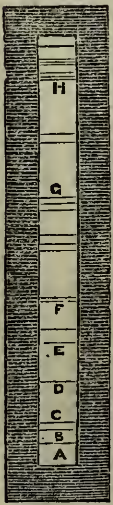

Fig. 243.

Moreover, in many instances, it has been found that if we use different prisms which give spectra of equal lengths, the coloured spaces are unequally spread out. This shows that media differ in their refracting action upon particular rays, some acting upon one colour more powerfully than another. This is called irrationality of dispersion.

The different coloured rays of light are not equally luminous—that is to say, do not impress our eyes with an equal brilliancy. If a piece of finely-printed paper be placed in the spectrum, we can read the letters at a much greater distance in the yellow than in the other regions, and from this the light declines on either hand, and gradually fades away in the violet and the red.

It has also been found that the colours are not continuous throughout, but that when delicate means of examination are resorted to the spectrum is seen to be crossed with many hundreds of dark lines, irregularly scattered through it. A representation of some of the larger of these is given in Fig. 243. It is curious that though they exist in the sun-light, and in that of the planets, they are not found in the spectra of ordinary artificial lights; and, indeed, the electric spark gives a light which is crossed by brilliant lines instead of black ones. The chief fixed lines are designated by the letters of the alphabet, as shown in the figure.

The light of the sun is accompanied by heat. Dr. Herschel found that the different coloured prismatic spaces possess very different power over the thermometer. The heat is least in the violet, and continually increases as we descend through the colours, the red being the hottest of them all. But below this, and out of the spectrum, when there is no light at all, the maximum of heat is found. The heat of the sunbeam is therefore refrangible, but is less refrangible than the red ray of light.

Late discoveries have shown that every ray of light can produce specific changes in compound bodies. Thus it is the yellow ray which controls the growth of plants, and makes the leaves turn green ; the blue ray which brings about a peculiar decomposition of the iodides and chlorides of silver, bodies which are used in photogenic drawing. Those substances which phosphorescence after exposure to the sun are differently affected by the different rays—the more refrangible producing their glow, and the less extinguishing them.

CHAPTER XL.

OF COLOURED LIGHT.

Properties of Homogeneous Light—Formation of Compound Colours—Chromatic Aberration of Lenses—Achromatic Prism—Achromatic Lens—Imperfect Achromaticity from Irrationality of Dispersion—Cause of the Colours of Opaque Objects—Effects of Monochromatic Lights—Colours of Transparent Media.

Each colour of the prismatic spectrum consists of homogeneous light. It can no longer be dispersed into other colours, or changed by refraction in any manner. Thus let a ray of light, S, Fig. 244, enter through an aperture, F, into a dark room, and be dispersed by the prism, ABC; through a hole, G, in a screen, DE, let the resulting spectrum pass, and be received on a second screen, *d e*, placed some distance behind; in this let there be a small opening, *g*, through which one of the coloured rays of the spectrum, formed by A B C, may pass and be received on a second prism, *a b c*. It will undergo refraction, and pass to the position M on the screen, N M. But it will not be dispersed, nor will new colours arise from it; and it is immaterial which particular ray is made to pass the opening at *g*, the same result is uniformly obtained.

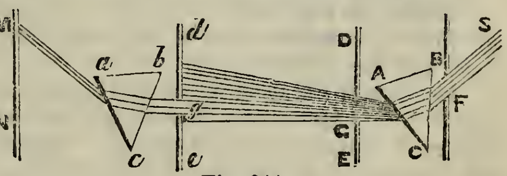

Fig. 244.

Homogeneous or monochromatic colours, therefore, cannot suffer dispersion.

By the aid of the instrument Fig. 245, which consists of a series of little plane mirrors set upon a frame, we can demonstrate, in a very striking manner, the constitution of different kinds of lights; for if this instrument be placed in such a manner as to receive the prismatic spectrum, by turning its mirrors in a suitable position we can throw the rays they receive at pleasure on a screen. Thus, if we mix together the red and blue ray, a purple results; if the red and yellow, an orange; and if the yellow and blue, a green. It is obvious, therefore, that of the colours we have enumerated in Chapter XXXIX., as the seven prismatic rays, the green, the indigo, and violet may be compound, or secondary ones, arising from the intermixture of red, yellow, and blue, which by many philosophers are looked upon as the three primitive colours.

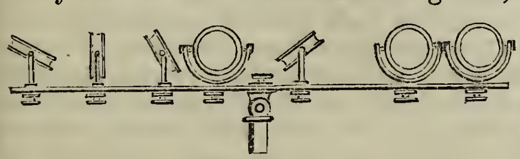
Fig. 245.

We have already remarked that there is an analogy between prisms and lenses in their action on the rays of light, and have shown how rays become converging or diverging in their passage through those transparent solids. In the same manner it also follows, that as prisms produce dispersion as well as refraction, so, too, must lenses; for, by considering the action of pairs of prisms, as in Fig. 246, or as we have already done in Chapter XXXVIII., we arrive at the action of concave and convex lenses, and find that as refrangibility differs for different rays —being least for the red and most for the violet—a lens acting unequally will cause objects to be seen through it fringed with prismatic colours. This phenomenon passes under the title of chromatic aberration of lenses.

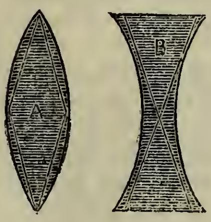

Fig. 246.

To understand more clearly the nature of this, let parallel rays of red light fall upon a plano-convex lens, A B, Fig. 247, and be converged by it to a focus in the point *r*, the distance of which from the lens is measured. Then let parallel rays of violet light, in like manner, fall on the lens, and be converged by it to a focus, *v*. On being measured it will be found that this focus is much nearer the lens than the other; and the cause of it is plainly due to the unequal refrangibility of the two kinds of light. The violet is the more refrangible, and is, therefore, more powerfully acted on by the lens, and made to converge more rapidly.

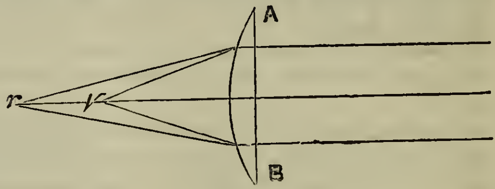

Fig. 247.

But this which we have been tracing in the case of homogeneous rays must of course take place in the compound white light. On the same principle that the prism separates the white light into its constituent rays by acting unequally on them, so, too, will the lens. Parallel rays of white light falling on a lens, such as Fig. 247, are not, therefore, converged to one common focus, as represented in Chapter XXXVIII., but in reality give rise to a series of foci of different colours, the red being the most remote from the lens, and the violet nearest.

In some of the most important optical instruments it is absolutely necessary that this defect should be avoided, and that a method should be hit upon by which light may be refracted without being dispersed. Newton, who believed that it was impossible to succeed with this, gave up the improvement of the refracting telescope, in which it is required that images should be formed without chromatic dispersion, as hopeless. But, subsequently, it was shown that refraction without dispersion can be effected. This is done by employing two bodies having equal refractive but unequal dispersive powers. Those which are commonly selected are crown and flint glass, which refract nearly equally. The index for crown being about 1·53, and that of flint 1·60; but the dispersion of good flint glass is twice that of crown.

If, now, we take two prisms, A B C, Fig. 248, being of crown, and A C D of flint glass, and place them, with their bases in opposite ways, the refracting angle, C, of the latter being half that of A, the former, or, in other words, adjusted to their relative dispersive powers, it will be found that a ray of light passes through the compound prism, undergoing refraction, and emerging without dispersion; for the incident ray, in its passage through the crown prism, will be dispersed into the coloured rays, and these, falling on the flint prism—the dispersive power of which we assume to be double, and acting in the opposite direction—will be refracted in the opposite direction, and emerge undispersed. Such an instrument is called an achromatic prism.

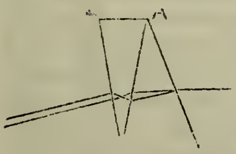

Fig. 248.

The same principle can, of course, be used in the construction of lenses, between which and prisms there is that general analogy heretofore spoken of. The achromatic lens consists of a concave lens of flint and a convex one of crown, the curvatures of each being adjusted on the same principle as the angles of the achromatic prism are determined. Such an arrangement is represented in Fig. 249. It gives in its focus the images of objects in their natural colours, and nearly devoid of fringes. But, in practice, it has been found impossible, by any such arrangement, to effect the total destruction of colour. The edges of luminous bodies seen through such lenses are fringed with colour to a slight extent. This arises from the circumstance that the dispersive powers of the media employed are not the same for every coloured ray. The simple achromatic lens, Fig. 249, will collect the extreme rays together; but leaves the intermediate ones, to a small extent, outstanding.

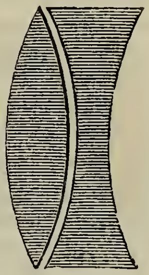
Fig. 249.

The theory of the compound constitution of light enables us to account, in a clear manner, for the colours of natural objects. Those which exhibit themselves to us as white merely reflect back to the eye the white light which falls on them, and the black ones absorb all the incident rays. The general reason of colouration is, therefore, the absorption of one or other tint, and the reflection of the rest of the spectral colours. Thus an object looks blue because it reflects the blue rays more copiously than any others, absorbing the greater part of the rest. And the same explanation applies to red or yellow, and, indeed, to any compound colours, such as orange, green, &c. That coloured bodies do, in this way, reflect one class of rays more copiously than others, may be proved by placing them in the spectrum. Thus, a red wafer seems of a dusky tint in the blue or violet regions, but of a brilliant red in the red rays.

On the same principles we account for the singular results which arise when monochromatic lights fall on surfaces of any kind. Thus, when spirits of wine is mixed with salt in a plate, and set on fire, the flame is a monochromatic yellow—that is, a yellow unaccompanied by any other ray. If the variously coloured objects in a room are illuminated with such a light they assume an extraordinary appearance: the human countenance, for example, taking on a ghastly and death-like aspect; the red of the lips and cheeks is no longer red, for no red light falls on it; it therefore assumes a grayish tint.

The colours of transparent bodies, such as stained glass and coloured solutions, arise from the absorption of one class of rays and the transmission of the rest. Thus, there are red glasses and red solutions which permit the red ray alone to traverse them, and totally extinguish every other. But, in most cases, the colours of transparent, and also of opaque bodies, are far from being monochromatic. They consist, in reality, of a great number of different rays. Thus, the common blue-stained glass transmits almost all the blue light that falls upon it, and, in addition, a little yellow and red.

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EXTRAORDINARY INSTANCE OF STUDIOUS PERSEVERANCE.

One of the most remarkable names connected with the improvement of *Pottery*, is that of Bernard Palissy. "He was born," says Mr. Marryatt, in his *Collections towards a History of Pottery and Porcelain*, about the year 1500, of very humble parentage, and was denied even the common rudiments of education; nevertheless, by great industry and perseverance, he contrived to teach himself reading, writing, and drawing. He also undertook the study of chemistry, and became acquainted with the composition and properties of minerals.

When thirty-nine years of age, a spirit of discovery was awakened in him by seeing a beautiful cup of enamelled pottery. He devoted the next *sixteen years* of his life to incessant and almost hopeless labour to the re-discovery of this art. In the pursuit of it, he was frequently reduced to the greatest extremities—but nothing could deter him from continuing his experiments. He borrowed money to construct a furnace, and when wood failed him, he actually burnt the tables and boards of his house to furnish the operation, which succeeded but imperfectly. He discharged his only workman, and not having money to pay him, he gave him part of his clothes.

At last his efforts were crowned with success. His ware was first brought into notice by Henry II. and Diana of Poictiers, and from that time he continued as manufacturer of pottery to the Court of France.

LESSONS IN NATIONAL HISTORY.

No. II.

> Her ample page,
> Rich with the spoil of time.

CAPTURE OF CONSTANTINOPLE BY THE TURKS IN 1453.

In proceeding with our Sketches of National History, it would be in vain to attempt anything like chronological order in a periodical so limited for room as the Tutor. We must therefore, at least for the present, satisfy ourselves with occasional glances at those remarkable epochs, or particular periods of the world, in which important changes have been effected in the fate of nations, or the condition of society. At the same time we should advise the student generally to provide himself with a "Stream of History," as well as a map of the world, in order to judge of the position of coeval states or empires at any particular period under consideration.

The important secret of attaining historic knowledge is to impress upon the mind the most striking epochs in the world's annals, and compare therewith the contemporary events which chronology presents. The intervening lacunæ can be impressed by degrees on the tablet of the memory. Thus the capture of Constantinople by the Moslems, in 1453, to which we adverted in our last number, is unquestionably the most important event that has occurred in mediæval history from the period of the destruction of Rome by Odoacer, King of the Heruli, A.D. 476. Constantinople was the ancient Byzantium of classical history, and rose upon the ruins of the "Eternal City." She was the seat of learning and civilization for a long succession of ages. The literary treasures of Greece and Rome found protection within her walls; and Christianity was there first acknowledged, and taken under the protection of the civil power. With Constantine its greatness took its rise, and with a Constantine, after the lapse of eleven centuries, it fell before the all-conquering sword of the Moslems. The history of her fall, when the eyes of all Europe are anxiously directed to her coming fate, cannot fail to be interesting. With the ruin of the city, the destruction of the Greek empire was accomplished, and the stores of ancient learning and philosophy annihilated; when, upon their ruins, arose the barbarous Moslem power, which possessed no other recommendation than the sword, and exhibited no other spirit than hatred to the Christian name.

When Mahomet II. succeeded to the empire of the Turkish Sultans, his first thought was the conquest of ancient Byzantium. Its siege was fixed to begin in the spring of the year 1453; and the Greeks and Turks passed the winter in preparing for the defence and the attack. While Mahomet was thus making immense preparations, Constantine Palæologus, the Emperor of Constantinople, implored assistance from all the principal nations of Europe. But it was in vain that Constantine promised, as all his predecessors had done, to unite the Greek Church with the Roman Church. The remembrance of so many promises, made in the hour of peril, and forgotten in time of safety, only added to the antipathy of the Latins for the Greeks. The Pope exhorted the feeble warriors of the West to take up arms to assist their Christian brethren of the East; but it was all in vain. With the exception of partial aid from the Genoese and the Venetians, Constantine was left to his own resources.

And now Mahomet had completed his immense preparations. As the conquest of Byzantium and the pillage of Constantinople were the richest recompense that could be offered to the valour of the Ottomans, all the soldiers were, in some sort, associated with the ambition of their leader. The warlike ardour and fanaticism which had distinguished the companions of Omar and the first champions of Islamism were now revived. From all the regions which extend from the chain of Taurus to the banks of the Ebro and the Danube came crowds of warriors, attracted to the army by the hopes of booty or the desire of distinguishing themselves in a religious and national war. In order at once to give a clear idea of the decay and weakness of the Greeks, and of the strength and power of the Ottomans, it will suffice to say that Constantinople, and all that remained of the territory of the empire, contained a smaller number of inhabitants of all kinds than Mahomet mustered soldiers beneath his banners.

The Sultan's forces set out from Adrianople at the beginning of March; and on the 6th of April Mahomet pitched his tent before the gate of St. Romanus. The signal for battle was speedily given on both sides. In the early days of the siege, the Greeks and the Turks displayed all that the art of war had invented or perfected among the ancients and moderns. Among his formidable preparations, Mahomet had not neglected artillery, the use of which was then spread through the West. One of his cannons, founded under his own eyes at Adrianople, was of such gigantic proportions, that three hundred oxen dragged it along with difficulty, and it launched a ball of seven hundred quintals (seven hundred pounds weight) to a distance of more than six hundred toises (six hundred fathoms).

The Sultan resolved to make a last effort to render himself master of the port of Constantinople. As the entrance of it was guarded by several large vessels, and closed by a chain of iron that could neither be broken nor passed, the Ottoman monarch employed an extraordinary method, which the besieged had not foreseen, and the success of which displayed the force of his will and the extent of his power. In a single night, between seventy and eighty vessels, which were at anchor in the canal of the Black Sea, were transported by land to the gulf of Ceras. The road was covered with planks, plastered with grease, along which a multitude of soldiers and workmen made the vessels slide. The Turkish fleet, commanded by pilots, with sails unfurled, as if upon a maritime expedition, advanced over a hilly country, and traversed a space of two miles by the light of torches and flambeaux, to the sound of clarions and trumpets, without the Genoese, who inhabited Galata, daring to offer any opposition to its passage. The Greeks, fully occupied in guarding their ramparts, had no suspicion of the designs of the enemy. They could not comprehend what could be the cause or the object of all the tumult that was heard during the whole night from the sea-shore, until the dawn of day showed them the Mussulman standards floating in their port.

Scarcely were the Turkish boats launched, when a multitude of workmen were busily engaged in constructing floating batteries on the same spot where the Venetians made their last assault in the fifth crusade. This bold enterprise, carried out with such audacity and success, spread trouble and consternation among the besieged. They made several attempts to burn the fleet and destroy the works the enemy had begun; but they in vain had recourse to the Greek fire, which had so often saved Constantinople from the attacks of the barbarians. Forty of their most intrepid warriors, betrayed by their imprudent valour, and perhaps also by the Genoese, fell into the hands of the Turks, and a death amidst tortures was the reward of their generous devotion. Constantine used reprisals, and exposed the heads of seventy of his captives upon the ramparts. This mode of making war announced that the combatants no longer listened to anything but the inspirations of despair or the furies of vengeance.

During the siege, capitulation had been several times spoken of. Mahomet required that the capital of an empire, of which he already possessed all the provinces, should be given up to him, and he would permit the Greeks to retire with their treasures. Palæologus was willing to consent to pay a tribute, but he would not give up Constantinople. At length, in a last message, the Sultan threatened to immolate the Greek Emperor with his family, and scatter his captive people throughout the earth, if he persisted in defending the city. Mahomet offered his enemy a principality in the Peloponnesus; Constantine rejected this proposition, and preferred a glorious death. From that moment peace was no more mentioned, and Byzantium was left to the chances of an implacable war. The Sultan announced to the army an approaching general assault: the wealth of Constantinople, the captives, the Greek women, were to be the rewards of the valour of the soldiers; he for himself only reserved the city and the edifices. To add religious enthusiasm to that of war, dervises pervaded the ranks of the Ottoman army, exhorting the soldiers to purify their bodies by ablutions, and their souls by prayer; and promising the delights of paradise to the defenders of the Mussulman faith. At the end of the day, great fires, lighted by the orders of the Sultan, spread a lurid splendour over all the shores of the sea, from the point of Galata to the Golden Gate. The Ottoman Emperor then appeared in the midst of his army, promising again the plunder of Byzantium to his soldiers; and, to render his promise more solemn, he swore to it *by the soul of Amurath, by four thousand prophets, by his children, and lastly by his cimeter.* The whole army burst forth in exclamations of joy, and repeated several times: *God is God, and Mahomet is the messenger of God.* When this warlike ceremony was finished, the Sultan ordered, under pain of death, that profound silence should be observed throughout the camp; and from that moment nothing was to be heard around Constantinople but the confused tumult of an army in which everything was in motion, preparing for a decisive combat.

The sun of the last day of the Roman empire arose: it was the 29th of May. The signal for assault was given to the Turkish army before dawn; the multitude of Mussulman soldiers rushed towards the walls of the city. The attack was made at the same time on the side of the port, and near the gate of St. Romanus. In the first charge, the assailants everywhere met with a firm resistance; the Catalans and the Genoese did all that the courage of Franks could effect. Palæologus fought at the head of the Greeks, and the sight alone of the imperial banner filled the Ottoman soldiers with terror. The historian Phrantza compares the close ranks of the Mussulmans to an extended tightened cord, which might have been placed round the city. The towers which defended the gate St. Romanus crumbled away beneath the blows of the rams and the discharges of the Ottoman artillery. The exterior walls were carried; the dead and the wounded, confounded with the ruins, filled up the ditches. And yet upon this horrible field of battle the defenders of Byzantium fought still; nothing could weary their constancy, nothing could shake their courage. After two hours of frightful conflict, Mahomet advanced with his chosen troops and ten thousand janissaries. He appeared in the midst of them, with his mace in his hand, like the angel of destruction. His threatening looks animated the ardour of his soldiers, and he pointed out to them by his gestures the points that were to be attacked. Behind the battalions he led, a troop of those men whom despotism charges with the execution of its vengeance punished or constrained all who wished to fly, and forced them forward to the carnage. The dust which arose from the steps of the combatants, with the smoke of the artillery, covered both the army and the city. The clang of the trumpets, the crash of the ruins, the explosion of the cannons, and the shock of arms, completely drowned the voices of the leaders. The janissaries fought in disorder; and Constantine, who had remarked it, was exhorting his soldiers to make one last effort, when the aspect of the fight became all at once changed. Justinian having been struck by an arrow, the pain of the wound was so intense as to force him to quit the field of battle. The Genoese, and most of the Latin auxiliaries, followed his example. The Greeks, left alone, are soon overwhelmed by numbers; the Turks pass the ramparts, get possession of the towers, and break open the gates. Constantine fought still; but soon, covered with wounds, he fell among the heap of dead, and Constantinople was without a head and without defenders.

The massacre of the unarmed inhabitants, the city given up to pillage, holy places profaned, virgins and matrons overwhelmed with outrages, an entire population loaded with chains; such are the horrible pictures that are to be found in the annals of the Turks, the Greeks, and the Latins. Such was the fate of that city which frequent revolutions had covered with ruins, and which became at length the ridicule and the prey of a nation it had long despised. If there be anything consolatory amidst so many distressing scenes, it is the virtue of Constantine, who would not survive his country, and whose death was the last glory of the empire of the East.

The barbarians, who overthrew the empire of the West, adopted the religion and manners of the conquered nations. The Turks, on the contrary, were resolved to make the Koran triumph wherever they carried their arms. As soon as they were masters of Constantinople, the altars of Christianity were overturned, and everything changed.

TURKEY AND RUSSIA.

For the four last centuries Constantinople, from its capture by Mahomet, has remained in the hands of the Turks; but looking at the march of events in Europe, we may safely vaticinate that the time is rapidly approaching, when the city of Constantine is again destined to revert to a Christian dynasty; and that dynasty must be of the Russo-Greek Church. Whilst the Ottoman power has been gradually waning, the steady march of Russian dominion, since the time of Peter the Great, has been of a grand and imposing character. On his accession, in 1689, the Western boundary of Russia was in longitude 30°, and its Southern in latitude 42°: these have now been pushed to longitude 18° and latitude 39° respectively. Russia had then no access to any European sea; her only ports were Archangel in the Frozen Ocean and Astrakhan on the Caspian: she has now access both to the Baltic and the Euxine. Her population, mainly arising from increase of territory, has augmented thus:—At the accession of Peter the Great, in 1689, it was 15,000,000; at the accession of Catherine the Second, in 1762, it was 25,000,000; at the accession of Paul, in 1796, it was 36,000,000; at the accession of Nicholas, in 1825, it was 58,000,000. By the treaty of Neustadt, in 1721, and by a subsequent treaty in 1809, she acquired more than half the kingdom of Sweden, and the command of the Gulf of Finland, from which before she was excluded. By the three partitions of Poland, in 1772, 1793, and 1795, and by the arrangements of 1815, she acquired territory nearly equal in extent to the whole Austrian empire. By various wars and treaties with Turkey, in 1774, 1783, and 1812, she deprived her of territories equal in extent to all that remains of her European dominions, and acquired the command of the Black Sea. Between 1800 and 1814, she acquired from Persia districts at least as large as the whole of England, and from Tartary a territory which ranges over 30 degrees of longitude. During this period of 150 years, she has advanced her frontier 500 miles towards Constantinople, 630 miles towards Stockholm, 700 miles towards Berlin and Vienna, and 1000 miles towards Teheran, Cabool, and Calcutta. One only acquisition she has not yet made, though steadily pushing towards it, earnestly desiring it, and feeling it to be essential to the completion of her vast designs and the satisfaction of her natural and consistent ambition,—namely, the possession of Constantinople and Roumelia; which would give her the most admirable harbours, and the command of the Levant.

IMPORTANCE OF ASTRONOMY IN THE ORDINARY AFFAIRS OF LIFE.

The question has been frequently asked—and even by many of our own correspondents—"Of what practical utility is Astronomy in the ordinary avocations of life?" "It may be the sublimest of all the sciences," says another, "but if it be not practically useful to the student, the labours of the tutor are thrown away, and more valuable studies neglected."

It may be true that Astronomy, though the sublimest of all the sciences, may not be of the same practical utility, in the ordinary affairs of domestic life, as reading and writing, arithmetic or language, mathematics or chemistry, because its sublimer objects can only be pursued by men of the loftiest minds, and of the highest scientific attainments. But although few of us can expect to be a Newton or a Herschel, we must always bear in mind that many of the most useful arts, and much practical every-day information, have been derived from astronomical observations. Astronomy can be traced as far back as authentic history, and its origin seems lost in the night of time. While in all ages it has ever been, and still continues to be, of the greatest use, as applied to the measurement of time—to navigation and to geography, its history furnishes an important clue to the explanation of ancient fables and the origin of numerous religions which had their birth in mystic or primeval ages.

As indicating the signs of the seasons, astronomy has ever been of the first importance. From the earliest periods to the present time the heavenly bodies were made use of to measure the parts of the year. Their regular returns were compared with the periodical returns of terrestrial phenomena, and made use of to designate the year, the seasons, the months, the days, and the hours. Almanacs, calendars and ephemerides of all kinds are founded on this science; and without it we should be destitute of the means of safe navigation; we should be incapable of acquiring a correct geography of our own planet, and should have but a very imperfect knowledge of the seasons of the year, and the appropriate occupations of the husbandman in each.

Astronomy, too, extends our knowledge of mundane existence. By it we find that the whole of our magnificent solar system is but an immeasurably small part of the whole that we can see of the universe; and we are led to the discovery of worlds, and of their formation placed at a distance beyond all human computation, which obliges us to admire the great harmony of nature that prevails in the stupendous mechanism of the heavens.

The great antiquity of the constellations, and the fulness of all ancient works on natural history, with astronomical allusions, and of all poems with astronomical fables, show the important place that this science held in the estimation of our forefathers from time immemorial. Agricultural observations in ancient times were regulated by the rising and setting of the signs of the Zodiac and other constellations; and these accurately compared with the flowering of plants, the arrival of birds, and other natural phenomena, became the basis of the earliest rustic calendars.

The illustrious Roman bard begins his poem of the Georgics with the celestial signs of the seasons; whence, he says, he dates the subjects of his song.

"Quid faciat lætas segetes; quo sidere terram
Vertere, Mæcenas, ulmisque adjungere vites,
Conveniat; quæ cura bovum, qui culus habendo
Sit pecori; atque apibus quanta experientia parcis;
Hinc canere incipiam. Vos, ô clarissima mundi
Lumina, labentem cœlo quæ ducitis annum."

The familiar acquaintance with the times of rising and setting of the stars, must have been a source of great amusement as well as profit to shepherds, mariners, and husbandmen of old, who, being constantly abroad in a fine climate and beneath a sky almost perpetually serene, must have had abundant opportunity of observing the heavenly phenomena.

Cicero lays the foundation of the science of the signs to the Assyrians and Babylonians; others ascribe it to the Indians and Egyptians. Be this as it may, it was highly cultivated in Greece and Rome at an early period; it was the basis of Phœnician navigation, and consequently the support of early commerce and of the discovery of new countries.

Planting, sowing, and in-gathering by the stars is as ancient as any record we possess of agriculture; and pastoral life has left no traces behind it unconnected with accounts of the celestial warnings of the heavenly spheres. The ancient mariner had his "Tyrian Cynosure," the stedfast index of the northern pole; he watched for the rainy Hyades, the stormy Orion, the *signum pluviale Capellæ,* and he knew by the rising of the Pleiades the time when the seas were open for sailing, and guarded against tempests by the setting of Arcturus and the rising of the Hœdi; he knew the hour of the day by the Sun, and kept the night watches by the Bear. The husbandman, likewise, marked the seasons by the stars; he waited for the annual overflowing of the Nile, till admonished of its approach by Sirius; he knew the *atrox hora Caniculæ;* he marked the return of spring in the setting of Pisces, and he compared it with the coming of the Swallow; in short, all rustic operations had their admonitory signs; and the knowledge of agriculture began with the science of the Zodiac. While the shepherd, in his turn, no less dependent than the rest on the heavenly movements, had his star of Arcady, and his Pascal Aries: he drove afield with the morning ray of Phosphorus, and at eventide watched for "the star that bid the shepherd fold."

Many of the constellations constitute a very curious object of antiquarian research. For we find the greater part of them to have been designated by their present names at the remotest period to which our authentic history reaches. Some of the most curious specimens of antiquity are the ancient Zodiacs found carved or engraven on stones in the eastern parts of the world. Many of these inscriptions are probably four thousand years old. The best collections of ancient Zodiacs and Constellations is to be found in Dupin's "Essai sur l'origine de tous les Cultes," and in Sir William Drummond's "Œdipus Judaicus."

Some of the constellations are mentioned in the ancient Jewish records. In Job we find allusion to "Arcturus and Orion, and the Pleiades, and the chambers of the south;" and in another place we read, "Who shall bind the sweet influence of the Pleiades, or loose the bands of Orion." Hesiod and Homer mention the Pleiades and many other constellations. Aratus wrote a poem on them in Greek, in which he mentions nearly all according to their order of rising. Manlius imitated him in a Latin poem; and Ovid's *Tristia* is a sort of poetical calendar indicating the times of rising of the then known constellations.

LESSONS IN FRENCH.

THE PRONOUN.

Of Personal Pronouns used as indirect Objects of a Verb with any Preposition except the Preposition To.—Whenever a verb has a personal pronoun for its object, and governs any other preposition than the preposition *to,* that preposition and the pronoun should be placed after the verb in French, as in English, and the pronouns expressed as follows: *Me, moi; thee, toi; him, lui; her, elle; us, nous; you, vous; them,* (masc.) *eux.* (fem.) *elles;* [we will hereafter speak of the pronouns *it* and *them,* speaking of things;] as in, He speaks of me, Il parle *de moi.* I will go with thee, J'irai *avec toi.* I cannot go there without him, Je ne puis pas y aller *sans lui.* I will know it by her, Je le saurai *par elle.* You are angry with us, Vous êtes faché *contre nous.* I shall be there before you, J'y serai *avant vous.* I came after them, Je vins *après eux*, or *elles.* This rule has no exceptions, except in the case of the pronouns *it* and *them* (speaking of things), used with the preposition *of,* when they are both expressed by *en,* which precedes the verb in all its tenses, except in the imperative mood used affirmatively; as in, I spoke of it (or of them) half an hour ago, J'*en* parlais il y a une demi-heure. Speak of it now, if you please, Parlez-*en* à présent, je vous prie.

We shall hereafter devote a whole chapter to the pronoun *it* when preceded by a preposition which cannot be contracted with that pronoun, as in the word *en.*

Of the Personal Pronouns Him, Her, *and* Them, *followed by a Relative Pronoun, preceded or not by a Preposition.*—Whenever the personal pronouns *him, her,* and *them* are followed by a relative pronoun, preceded or not by a preposition, they sometimes become in French demonstrative pronouns, signifying *that person* or *those persons,* and are then expressed by *celui, him; celle, her; ceux, them* (masculine), *celles, them* (feminine); as in, I have been deceived by her whom I loved the most, J'ai été trompé par *celle que* j'aimais le plus. Put yourself in the place of him to whom you would do an injury, Mettez-vous à la place de *celui à qui* vous voulez faire une injure. But when the pronouns *him, her,* and *them* are not used in the sense of *that person* or *those persons,* and are only employed instead of a noun of person, singular or plural, they retain their character of personal pronouns, the relative pronoun which follows them forms an incidental proposition with the following verb, and they are expressed as objective pronouns by *lui, elle, eux, elles;* as in, I have been deceived by her, whom I loved so much, J'ai été trompé par *elle, que* j'aimais tant. I was betrayed by them, whom I trusted so much, J'ai été trahi par *eux,* en qui j'avais tant de confiance. Should the personal pronoun be the direct object of the verb, that personal pronoun should be expressed twice,—once before the verb, the second time before the relative pronoun with which it forms the incidental proposition; as in, I love him still who has betrayed me so many times, Je *l*'aime encore *lui* qui m'a trahie tant de fois. But if the relative pronoun should not form an incidental proposition with the following verb, the objective pronoun placed before the verb would act as an antecedent for that pronoun, and its reduplication be unnecessary; as in, I see them advancing in good order, Je *les* vois *qui* s'avancent en bon ordre.

OF REFLECTED PRONOUNS.

Objective pronouns, when they are in the same number and person as the nominative of the verb of which they are the objects, are called by grammarians reflected pronouns; they are expressed in English by *myself, thyself, himself,* &c. Those pronouns, in French, vary according to their being placed before or after the verb.

Of Reflected Pronouns used with Active Verbs, and Neuter Verbs governing the Preposition To.—Whenever a reflected verb is active, or, being neuter, governs the preposition *to,* the reflected pronouns are placed before that verb, in all its tenses, except in the imperative mood used affirmatively, the preposition *to* is omitted, and they are expressed as follows: *Myself,* or, *to myself, me; thyself,* or, *to thyself, te; himself, herself, itself,* or, *to himself, to herself, to itself, se; ourselves,* or, *to ourselves, nous; yourselves,* or, *to yourselves, vous; themselves,* or, *to themselves, se;* as in, I love myself, I (myself) love, je *m*'aime. Thou lovest thyself, thou (thyself) lovest, tu *t*'aimes. He, or she, loves himself or herself, he, or she (himself or herself) loves, il *or* elle *s'*aime. We love ourselves, we (ourselves) love, nous *nous* aimons. You love yourself, or yourselves, you (yourself, or yourselves) love, vous *vous* aimez. They love themselves, they (themselves) love, ils *s'*aiment. I speak to myself, I (to myself) speak, je *me* parle. Thou speakest to thyself, thou (to thyself) speakest, tu *te* parles. He speaks to himself, he (to himself) speaks, il *se* parle. She speaks to herself, she (to herself) speaks, elle *se* parle. We speak to ourselves, we (to ourselves) speak, nous *nous* parlons. You speak to yourselves, you (to yourselves) speak, vous *vous* parlez. They speak to themselves, they (to themselves) speak, ils or elles *se* parlent.

The same English reflected pronouns, when employed with a verb in the imperative mood used affirmatively, are placed after that verb, and expressed as follows: *Thyself,* or, *to thyself, toi; ourselves,* or, *to ourselves, nous; yourself* and *yourselves,* or, *to yourself* and *to yourselves, vous;* as in, Love thyself, Aime-*toi.* Let us love ourselves, Aimons-*nous.* Love yourself or yourselves, Aimez-*vous.* Speak to thyself, Parle-*toi.* Set us speak to ourselves, Parlons-*nous.* Speak to yourself, Parlez-*vous.*

Of Reflected Pronouns used with any other Preposition than the Preposition To.—Whenever the pronouns *myself, thyself,* &c., are preceded by any other preposition than the preposition *to, à,* in French, whatever may be that preposition in English, they are expressed as follows: *Myself, moi* or *moi-même; thyself, toi* or *toi-même; himself, lui* or *lui-même; herself, elle* or *elle-même; ourselves, nous* or *nous-mêmes; yourself, vous* or *vous-même; yourselves, vous* or *vous-mêmes; themselves* (masc.), *eux* or *eux-mêmes,* (fem.) *elles* or *elles-mêmes.*

The word *même,* meaning *self,* should never be used with the pronoun except when an ambiguity would arise by employing the pronoun alone, or where the verb is emphatically used; as in, Why do you always speak so much of yourself? Pourquoi parlez-vous toujours tant *de vous?* (No ambiguity, and no emphasis.) Your sisters have too good an opinion of themselves, Vos sœurs ont trop bonne opinion *d'elles mêmes.* (Ambiguity without *même.*) This sentence would be ambiguous without the word *même,* because the pronoun *elles* employed alone could as well apply to any other ladies as to the nominative, *sisters.*

Of Active and Neuter Verbs, which, being used emphatically, require the Reflected Pronouns Moi-même, Toi-même, Lui-même, *&c., to be placed after them, whether they are reflected or not.*—It is often the case that in praising ourselves we reflect upon others, Il arrive souvent qu'en *nous* flattant *nous-mêmes* nous médisons d'autrui. We often excuse in ourselves the faults which we blame in others, Nous excusons souvent en *nous-mêmes* les fautes que nous blâmons chez les autres. Have you seen that yourself? Yes, I have, Avez-vous vu cela *vous-même?* Oui, je l'ai vu *moi-même.* Who has painted this landscape? It is my daughter; she did it herself, Qui a peint ce paysage? C'est ma fille; elle l'a peint *elle-même.* The first and second sentences would be flat, without the pronoun *vous-mêmes* being placed after the verb. The third is emphatically used, and signifies, *Are you very sure you have seen that?* The fourth is also emphatic, and means that the lady received no assistance in painting the landscape; that she has done it alone. But it would be ridiculous, in speaking of a lady, to say, for, *She has killed herself, Elle s'est tuée elle même,* because it is not to be supposed that any one would be inclined to assist her in committing a suicide; the reflected pronoun *se* placed before the verb is sufficient to show that she died by her own hands.

Of the Reciprocal Pronouns Each Other *and* One Another.—The reciprocal pronouns *each other* and *one another,* may be used with active and neuter verbs; the reciprocal verb, when neuter, may govern the preposition *to, à,* or any other. A reciprocal action requiring the interference of at least two persons, reciprocal verbs are always used in the plural. The reciprocal pronoun in French corresponding to the words *one another* and *each other,* is, *L'un l'autre* (sing. masc.), *l'une l'autre* (sing. fem.), *les uns les autres* (plu. masc.), *les unes les autres* (plu. fem.)

Of the Reciprocal Pronouns Each Other *and* One Another, *Employed with Active Verbs.*—When the verb which expresses the reciprocal action is active, that verb is, in French, both reflected and reciprocal; it is, therefore, preceded by a reflected pronoun of the same person and number as the nominative, and followed by the pronoun *l'un l'autre,* agreeing in gender with the nominative. As to its number, the two words *l'un l'autre* are used in the singular, if the reciprocal action takes place only between two persons, and in the plural if between more than two; as in, The two sisters of your friend love one another tenderly, Les deux sœurs de votre ami *s'*aiment *l'une l'autre* tendrement. These two children hate one another, Ces deux enfants *se* haïssent *l'un l'autre.* Wolves do not eat each other, Les loups ne *se* mangent pas *les uns les autres.* (More than two wolves.)

Of the Reciprocal Pronouns Each Other *and* One Another, *Employed with a Neuter Verb governing the Preposition* To, à.—When the verb which expresses the reciprocal action is neuter, and governs the preposition *to, à,* in French, that verb is still reflected and reciprocal; the preposition *à* is placed between the two words *l'un l'autre,* which compose the reciprocal pronoun, and this pronoun follows the same rule as in the preceding case, in relation to number, gender, and person ; as in, I would fain know what these two persons are saying to each other, Je voudrais bien savoir ce que ces deux personnes *se* disent *l'une à l'autre.* Rogues do not trust each other, Les fripons ne *se* fient pas *les uns aux autres.* (More than two rogues.) These houses are a nuisance to each other, Ces maisons *se* nuisent les *unes aux autres.* (More than two houses.)

Of the Reciprocal Pronouns One Another *and* Each Other, *employed with Neuter Verbs governing any other Preposition than the Preposition* To, à.—Whenever the verb which expresses the reciprocal action is neuter, and does not govern the preposition *to,* that verb is no longer reflected; but the reciprocal pronoun, *l'un l'autre,* keeps its place after it, and, as in the preceding case, the preposition is placed between the two words which compose that pronoun; as to the number and gender of these words, they follow the preceding rule ; as in, We speak of one another, Nous parlons *l'un de l'autre.* Why do these ladies always speak ill of one another? Pourquoi ces dames parlent-elles toujours mal *les unes des autres.* (More than two persons.) They will destroy each other, Il périront *les uns par les autres.* These two rooms communicate with each other by a passage, Ces deux chambres communiquent *l'une avec l'autre* par un corridor.

Of the Pronouns It *and* Them (*speaking of things*), *used as Direct Objects of a Verb.*—The personal objective pronouns *it* and *them* (speaking of things), when used without a preposition, have no other equivalent in French than *him, her,* and *them* (speaking of persons), expressed by *le, la,* and *les;* they present no difficulty, the language admitting that these pronouns, *le, la,* and *les,* should be indifferently applied to persons and things; thus we say, with the same propriety, Je *le* vois (speaking of a man or a horse); Je *la* vois (speaking of a woman or a cow); Je *les* vois (speaking of men, women, horses, and cows). But when the pronouns *it* and *them* (speaking of things) are preceded by a preposition, they have no equivalent in French different from *him, lui; her, elle; them* (masc.), *eux ; them* (fem.), *elles; to them, leur;* except in the case of the propositions *to* and *of,* which, with those pronouns, are expressed by the contracted pronouns *y* and *en,* and the genius of the French language does not always admit of these pronouns of *persons* being applied to *things.* A Frenchman, in this difficulty, should refer to usage and follow that of our best writers; but foreigners are deprived of this assistance—they want rules to guide them; we therefore will establish such principles as to enable them to express themselves correctly in all cases.

Of the Objective Pronouns It *and* Them, *preceded by the Prepositions* à *and* de *in French, whatever may be the Prepositions used in English instead of* To *and* Of.—Whenever the pronouns *it* and *them* (speaking of things) are preceded by the prepositions *of* and *to,* and relate to nouns of things not personified, they should be expressed by *en* for *of it,* and *y* for *to it ;* as in, As to this fact, if you speak of it, I will deny it, Quant à ce fait, si vous *en* parlez, je le nierai. It is in vain for me to remonstrate with you, you never pay attention to it, J'ai beau vous faire des remonstrances, vous n'*y* faites jamais attention. If you desire these books, I will make you a present of them, Si vous désirez ces livres, je vous *en* ferai présent. I will give you no more lessons; you do not pay attention to them, Je ne vous donnerai plus de leçons ; vous n'*y* êtes pas assez attentif. But *y* and *en,* although most generally applied to things, are sometimes used in speaking of persons; as in, I saw your brother, and I have spoken of him much with my son, J'ai vu votre frère, et nous *en* avons beaucoup parlé, mon fils et moi. Have you heard of the captains of your two ships? Yes, we heard of them this morning, Avez-vous reçu des nouvelles des capitaines de vos deux navires? Oui, nous *en* avons entendu parler ce matin. In the last appointments you have made, have you thought of my sons? Yes, I thought of them. Dans les dernières nominations que vous avez faites, avez-vous pensé à mes fils? Oui, j'*y* ai pensé.

In these sentences, or any other similar to them, it is evident that the mind alludes more intimately to things connected with the persons spoken of than to those persons themselves; the first sentence, for instance, signifies, *I have spoken of his interest* rather than *his person as a man;* the second, *We heard of their safety, or of their being in such situation,* rather than *we heard of them as being such, or such men;* the third implies the same meaning as the first. If the mind, on the contrary, should refer more intimately to the persons spoken of than to things connected with them, the pronouns of persons should be used with the preposition, and the preceding sentences should be rendered by:—Oui, j'ai beaucoup parlé *de lui* avec mon fils; Oui, nous avons entendu parler *d'eux*; Oui, j'ai pensé *à eux.*

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SECRET HISTORY OF ANCIENT ROME.

Recently, Signor Filopanti, late Professor of Hydraulics in the University of Bologna, and now an exile in this country, delivered three lectures on what might be called the Secret History of Ancient Rome. The Professor's object, according to his statement, is double—first, to vindicate the authenticity of the early Roman history against the objections of Niebuhr; and secondly, to explain what is obscure or mysterious in that history. In doing this, he explains whatever is apparently miraculous or absurd in the earliest known legends of Rome, by the agent of a secret society, whose object was to make Rome the capital of the world, and as a means to facilitate the attainment of so great a result, worked on the superstitious feelings of the times, with several devices calculated to lead people into the belief that the young city was under an especial and immediate protection of heaven.

The original founder of this secret society, or *Sodality,* as Professor Filopanti calls it, was, he says, the father of Romulus. His name was Denter Romulius. The lecturer told about him a very romantic story, which is pretended to have been handed down in this form by the secret tradition of the Sodality. Amilius, King of Alba, had made Rhea Sylvia, his brother Numitor's only daughter, a vestal, with the view of depriving her of issue. She, however, loved Denter Romulius, and was legitimately though secretly wedded to him in a grotto dedicated to the god Mars, during an eclipse of the sun. The violation of her virgin vows was discovered, and she was condemned to be buried alive. The subterranean room, however, which was destined to be her tomb, had a secret communication with the catacombs, and through a branch of them her husband led her to a place of safety. There she became mother to Romulus, the future king of Rome. The Sodality, however, had made her appear the mother of two supposed twin infants. These children were floated in a cradle on the waters of the Tiber, and suckled by a real she-wolf. The animal had been tamed expressly for this purpose. One of these children was Remus, whose real mother was Acca Laurentia, though the multitude regarded them as twin brothers to Romulus, and sons of Rhea Sylvia. The explanation of the most marvellous incidents connected with the origin of the eternal city, the professor purports to have learnt from certain secret traditions which were communicated to him. For these traditions, however, he does not claim any more credit of authenticity than may be conferred on them by their own intrinsic credibility, which he reserves himself to demonstrate in a work which is shortly to be published by him on the subject. As an illustration of the existence of secret societies among the ancients, and of the possibility of traditions having descended to us through secret channels from the remotest antiquity, he instanced some traditions of early Freemasonry.

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MIXED EDUCATION IN IRELAND.

It is now more than two-and-twenty years since, at the suggestion of Mr. Wise, our present minister at Athens, the national system of primary instruction was introduced by the Government, of which Lord Stanley, now Lord Derby, was a prominent member. The fundamental idea of that system was that of mixed education in all things appertaining to moral and intellectual training, while suitable opportunities for separate sectarian teaching were to be afforded to the pastors of all denominations. To carry out this purpose, a whole series of class books was carefully prepared under the joint superintendence and revision of the heads of the Anglican, Presbyterian, and Roman Catholic Churches; and, amongst other manuals of daily instruction, a volume of extracts from the Old and New Testaments, entitled *Scripture Lessons,* was prepared with elaborate care for the use in common of children of all persuasions. The intrinsic excellence and unquestioned fairness displayed in the compilation of the work, secured for it the sanction of the pious and tolerant of every creed; and it speedily became the universal class-book of the National Schools.

But while many clergymen of the Established Church thought fit to denounce the volume of Scripture extracts, as being what they termed "a mutilation of the Word of God," the Roman Catholics for the most part cheerfully availed themselves of a book which had been prepared and sanctioned by Archbishop Murray, as one of its joint editors, and which in point of fact contained nothing more than the historic facts and moral truths of Revelation. But things are now changed. Archbishop Cullen has undertaken to revise and re-constitute the entire discipline and practice of the Roman Catholic Church, which acknowledges him as its provincial head. In a late synod of the Roman Catholic bishops and clergy of the province of Leinster, an address or pastoral appears to have been adopted, in which two of the books made use of in the National schools are denounced by name. The one is a brief manual of the "Evidences of Christianity," composed by Archbishop Whateley, which is now declared to be fraught with Protestantising tendencies, and consequently interdicted.

This decision of the Roman Catholic synod was opposed by the Protestant clergy and patrons of the schools; but the National Board of Education, under whose guidance and control the primary schools which receive assistance from government are placed, have decided, as a standing rule, that wherever the parent of any child in any school shall object to the reading of the condemned volumes during school hours, not only Dr. Whateley's Book of Evidences, but the extracts from the Bible also, shall be banished from the school; thus virtually confirming the decision of the Roman Catholic synod.

The result of this decision is, that three of the most distinguished Protestant heads of the schools, Archbishop Whateley, ex-chancellor Blackburne, and Baron Greene, immediately resigned. Dr. Whateley has been a faithful servant in the cause of popular education for upwards of twenty years; and Baron Greene is a man of great attainments and excellence of character. It is said that the Doctor appealed from the decision of his colleagues to the government, and that he received a reply which he could not consider otherwise than as a dismissal.

Thus the national system of education in Ireland may be said to be in a critical position. Since the resignation of Dr. Whateley, the Protestant party have invited the patrons of National Schools to adopt the following petition on the subject:—

"We, the undersigned patrons of Irish National Schools, have viewed with surprise and indignation the late prohibition, by the National Education Commissioners, of certain books for general instruction which had been formally and unanimously sanctioned by them, and which mainly induced us to give in our adhesion to the system. We consider such conduct a gross breach of good faith, a violation of the fundamental principle on which the system was established, having an indirect tendency to oblige us to withdraw our schools from connexion with the board. We, therefore, humbly beg that such steps be taken as your lordships may deem most expedient to remedy the evil of which we complain."

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GREAT WALL OF NORTHERN CHINA.

CHINA AND ITS GREAT WALL.

The "Schoolmaster," it appears, "has been abroad" in the East to some effect. Either in the shape of a collegiate preceptor or a Protestant missionary—a Morrison or a Gutzlaff—he has penetrated the innermost recesses of the "celestial empire;" and we now discover that his precepts are fast revolutionizing the social and religious fabric of the "flowery land." The native Chinese have rebelled against Tartar domination, which has oppressed them for ages; and having everywhere defeated the Imperial forces, and captured Nankin and Amoy, they now declare themselves to be Protestant Christians. With the sword in one hand, and the Bible in the other, they are marching onwards with stern determination and irresistible force. Their book of religious precepts recognizes most of the truths held by Jews and Christians of the present day. The collection of prayers which it contains refers perpetually to the Saviour Christ as the "Redeemer from our sin." The ten commandments are enunciated almost literally after the Jewish text, although submitted to curious and original explanations. There seems great probability that, in the face of a movement which has for its animating principles nationality and a religious principle, the Tartars may not be long able to hold their own; and it is impossible to say what influence the insurrection, if it establishes and legitimates itself, may have upon the destinies of the east. The intercourse with China, which has hitherto been confined to the sea-ports, may henceforth be carried into the interior. The most extensive empire in the world, hitherto almost hermetically sealed against European influences, may be opened to English enterprize; and there is no question but that the present dynasty, and, perhaps, the entire Tartar race, may be eventually driven beyond the "GREAT WALL OF CHINA," which was originally built by the native Chinese as a northern boundary to protect themselves against the predatory incursions of the Tartar hordes, who eventually succeeded in subjugating the whole country. If the present insurrection proceeds northwards, as unquestionably it will, the sanguinary struggle between the two races may be eventually decided in the vicinity of the GREAT NORTHERN WALL, of which we have given the annexed representation,—the subject, at this time, being one of universal interest.

The Great Wall, called *Wan-lí Chang* (*i. e.* Myriad-mile Wall). by the Chinese, was built by Tsin Chíhwangti about B. C. 220, in order to protect his dominions from the incursions of the northern tribes. It is sufficient evidence of the solidity of its original construction, that it has remained so well preserved in a region of frosts and moisture. The ships of the late English Expedition visited the point on the coast of Liautung, at Shanhai wei, latitude 40° 4′ N., longitude 120′ 2′ E., where it commences its course, and which is described as a place of considerable trade; the gate here is called *Shanhai kwan*, or Hill-sea barrier. Lord Jocelyn describes it, when observed from the ships, as "scaling the precipices and topping the craggy hills of the country, which have along this coast a most desolate appearance." It runs along the shore for several miles, and terminates on the beach near a long reef. Its course from this point is west, a little northerly, along the old frontiers of the province of Chihlí, and then in Shansí, till it strikes the Yellow River, in latitude 39½° N., and longitude 111½° E. This is the best built part, and contains the most important gates, where garrisons and trading marts are established.

Within the province of Chihlí there are two walls, inclosing a good part of the basin of the Hăng ho west of Peking; the inner one was built by one of the emperors of the Ming dynasty. From the point where it strikes the Yellow River it forms the northern boundary of Shensí, till it touches that stream again in latitude 37° N., inclosing the country of the Ortous Mongols. Its direction from this point is north-west along the northern frontier of Kansuh to its termination near Kiayü kwan, through which the great road passes leading across Central Asia, in about longitude 99° E., and latitude 40° N.

From near the eastern extremity of the Wall in the province of Chihlí, extending in a north-easterly direction, is a wooden stockade, or palisade, which forms the boundary between Liautung and Kirin, and has been often taken, from its representation on maps, as a continuation of the Great Wall. It was erected by the Manchus, and garrisons are placed at the twelve gates through which the roads pass leading from Shingking into Mongolia.

The entire length of the Great Wall, including all the doublings, is estimated by McCulloch at 1250 miles. The construction of this gigantic work is somewhat adapted to the nature of the country it traverses. In the western part of its course it is less substantially built than in the eastern, being in some places merely a mud or gravel wall, and in others earth cased with brick. The eastern part is generally composed of a mound of earth and pebbles, faced with masonry, supported on a coping of stone, the whole being about 25 feet thick at the base, and 15 feet at the top, and varying from 15 to 30 feet high; the top is terraced with tiles, and defended by a slight parapet, the thinness of which has been taken as proof that cannon were unknown at the time it was erected.

There are brick towers upon it at different intervals, some of them more than 40 feet high, but the usual height is a little under that elevation. They are not built upon the Wall, but are independent structures, usually about forty feet square at the base, diminishing to thirty at the top; at particular spots, the towers are of two stories when they are nearly fifty feet in height.

This remarkable structure did, no doubt, in some degree, serve as a barrier against the incursions of the nomadic tribes near it for many ages after its erection, though it is plain from the facts of history that it availed but little against the attacks of their enterprising chieftains. At present, it is simply a geographical boundary, and, except at the passes, nothing is done to keep it in repair; most of the garrisons are located at these points. Beyond the Yellow River, to its western extremity, the Great Wall, according to Gerbillon, is chiefly a mound of earth or gravel, about fifteen feet in height, with only occasional towers of brick, or gateways made of stone. A structure of this sort, in such a climate, must of course soon be overgrown with trees of greater or less size; but none of those who mention having crossed it speak of this circumstance, from which it might be inferred that care was taken to prevent the growth of plants upon it.

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COMMERCIAL TRAVELLERS' SOCIETY'S SCHOOL.

This Institution, so important, in an educational point of view, to a very large and respectable portion of the trading community, is about to be removed from its present obscure locality, and take its stand, perhaps, as a future rival of the time-honoured radiance and collegiate glories of Harrow-on-the-Hill.

On the 21st of July, the foundation-stone of a new building was laid at Pinner, in Harrow-on-land, belonging to the North Western Railway. The present location of the school is at Wanstead; but the lease of the premises being about to expire, and the requirements of the school having largely increased, a new locality was determined upon; and Pinner was considered as the most appropriate spot for the purpose.

The new School-house is to be in the old English style of architecture; the materials of red brick, with stone facings. It has a frontage of 300 feet, and a depth of 48 feet. The plan consists of a large central hall, divided into two school-rooms, beneath which are the dining-halls. At each end of the hall are the dormitories. In the wings are the residences of the masters and mistresses, and above these are the infirmaries. Beneath the cloister-like arches is an area intended as a covered play-ground. The school will afford accommodation for 300 children. The architects are Messrs. Lane & Ordish.

Mr. Masterman, Member for the City of London, performed the ceremonies of inauguration, and Dr. Vaughan, the head-master of Harrow, assisted in the proceedings. The president, on giving "Prosperity to the Commercial Travellers' Schools," spoke in the strongest terms of the laudatory objects of the institution, and concluded by observing that the rule of education given in the Commercial Travellers' Schools had merits of its own, which gave it strong claims on the benevolent. Commercial travellers were a large and respectable class of the community; but, from the peculiar character of their avocation, they were not able to give that fostering care to their children which might be expected from persons differently situated. Their business frequently called them to distant parts of the country, and it was delightful for them to know, in all their vicissitudes, that their children would be carefully trained and educated in an institution which their fathers had supported. In the school a sound moral and religious education was provided, and it only required a more liberal application of funds to render it completely efficient for the purpose intended.

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Cambridge Tutors.—The authorities of St. John's have determined to make a considerable addition to their staff of assistant tutors. Fifteen of the Fellows are to be constantly employed in the duties of public tuition. Provision will be made for instruction in the new studies connected with the natural and moral science triposes; and by a well arranged system of lectures and a better classification of the students, the necessity of obtaining the assistance of private tutors will, in a great degree, be obviated.

PRACTICAL ESSAYS ON EDUCATION.

DUTIES OF THE TEACHER.—(*Continued.*)

It is a great desideratum that you should convince your scholars that you aim at their improvement, and that you desire their good. It will not, in general, take long to satisfy them of this, if you are so in reality. A mere declaration to that effect will be, it must be remembered, very far from proving it, or convincing them of it. You must show that you are their friend, by evidencing a greater regard for their welfare than for your own ease and convenience. "Deeds, not words," should be your motto in this respect.

Dr. Andrew Bell was well aware of what I here state. "A great deal depends," says he, in his account of the *Madras System,* "on every boy in the school being sensible (for every one of them has a judgment of his own) that you have in view only their good; or filling their minds by the uniform interest you take in their welfare and comfort, with a sure confidence that they will meet with your countenance, support, and favour, which is of great value to them whenever they do right; or teaching them, by their daily experience of your conduct towards them, to consider you as their friend, their benefactor, their guide, and their parent."

To give commands which you have not either time, ability, or intention to enforce, is a sure way to inculcate disobedience. If, therefore, you make a promise, keep it religiously. If you say that neglect of any duty shall be followed by punishment, be sure to inflict it. If you require any act to be done, see that it is executed precisely as you directed it to be performed. By keeping this important principle in view, you will be on your guard not to be hasty either in commanding or threatening. Deliberation is necessary to every person who has to exercise authority.

Take care, however, not to confound this wise delay with dilatoriness. Promptitude is the soul of discipline, especially when you have to deal with numbers. He who is pondering what he should do, and how he should do it, when the time of action has arrived, is pretty certain to be vanquished.

It is almost an impossibility to carry into effect for any length of time a regulation, however important, which is opposed to the general opinion of your school. Every school has a moral atmosphere of its own; there are certain prevalent notions which give a decided, and, to some extent, a peculiar character to the whole community. Now these sentiments and notions will be found, on investigation, to be almost invariably regulated by a very limited number of the pupils—the master-spirits of their little world; and it depends almost entirely on the conduct of the teacher whether these young demagogues shall be as thorns in his side, or pillars of his strength. These children are usually found amongst the most unruly and mischievous. The natural energy of their characters; the elasticity of their spirits; their consciousness of vigour;—all these tend to make them troublesome subjects. It is the more imperative, therefore, that a teacher should secure their co-operation in his plans; that he should discover a way to their hearts; and that he should know how to turn all this activity of mind into a proper and legitimate channel.

To gain the kind of ascendancy you wish over such characters, you must know how to secure the confidence and affection of all. You cannot, it is true, where large numbers of children are concerned, become acquainted with every trait of character which may distinguish each; you cannot follow them into the play-ground; the street, the field, or their own homes, and detect the motives which influence, and the feelings which are predominant, when they are away from your superintendence, and no longer under your control; but you can do much to secure such a share of their attachment and esteem as shall materially influence their conduct wherever they may be, or whatever may be their pursuits.

Now to the manner in which this is to be done.

Be particularly careful to observe in your conduct towards your pupils strict impartiality. Children are quick in the detection of injustice. That which is law, therefore, for one, must be law for all. It is true that you necessarily exercise feelings towards those who are habitually diligent and obedient, vastly different from the sentiments you entertain towards the idle and perverse. This is nothing but just, and can afford no reasonable ground of complaint.

The wrong commences when this preference is carried to the hall of legislation, and to the judgment-seat; and when the badly-disposed are made to bear burdens for their transgressions, from which the well-conducted are in a great measure exempt. Now, whatever be the motive, if you allow yourself to act thus unfairly, you will most certainly lose the confidence of your school —even of the subjects of your partiality.

Again; if you would win the hearts of the young, you must respect their feelings. Children are, in general, very sensitive, and easily wounded to the quick. A sneer, even, at their youthful enthusiasm, may do incalculable mischief.

Dr. Arnold's conduct to the students at Rugby School is worthy of commendation in this respect. He treated the boys as gentlemen and reasonable beings; he made them respect themselves by the mere respect he showed to them; he showed that he appealed and trusted to their own common sense and conscience. Lying, for example, he made a great moral offence; placing implicit confidence in a boy's assertion, and then, if a falsehood was discovered, punishing it severely, in the upper part of the school; when persisted in, with expulsion. Even with the lower forms, he never seemed to be on the watch for boys; and in the higher forms, any attempt at further proof of an assertion was immediately checked. "If you say so, that is quite enough—*of course,* I believe your word;" and there grew up in consequence a general feeling that "it was a shame to tell Arnold a lie—he always believes one."

You should also be careful how you rebuke your pupils for their misdeeds. The more delicately you touch their feelings, the more tender their feelings are likely to become. Many a teacher hardens and stupefies their moral sense, by the harsh and rough exposures to which he drags out the private feelings of the hearts of his pupils. A man may, by exercising great care, produce such a state of feeling in his schoolroom, that to address even the gentlest reproof to any individual in the hearing of another, will, of itself, be a severe punishment. On the other hand, he may so destroy that sensitiveness, that his vociferated reproaches will be as unheeded as the wind.

"On a meek and tender disposition," says a well-known teacher, "very slight marks of displeasure or approbation will produce a powerful effect; an angry look or word will succeed better as a correction on such a one, than stripes on the backs of the audacious." On the minds of many, praise and shame will at all times be sufficient.

"Praise them openly, reprehend them secretly," is the advice of Lord Burghley, and should not be ignored by the teacher anxious in every way to do his duty.

In illustration of the mode of rebuke that should prevail in a well-regulated school, I may mention the following anecdote by way of warning:—At Laleham, Dr. Arnold once got out of patience, and spoke sharply to a pupil of a "plodding" character, when the pupil looked up in his face and said, "Why do you speak angrily, sir?—indeed I am doing the best I can." Years afterwards the Doctor used to tell the story to his children, and say, "I never felt so much ashamed in my life—that look and that speech I have never forgotten."

Be it remembered, therefore, that reproofs should be always administered in sorrow rather than in anger. The greater the offender you are attempting to reform, the more needful is it to adopt the language and tones of friendship when obliged to rebuke.

In educating the ox for the plough, Cobbett recommended that all violence and rough usage should be avoided. "If he be stubborn, there should be no blows, and no loud scolding. Stop, pat him; pat the other ox; and he will presently move on again. If he lie down, let him lie till he is tired; and when he chooses to get up, treat him very gently, as if he had been doing everything that was right. By these means a young ox will in a few days be broken to his labour. With gentle treatment he is always of the same temper, always of the same aptitude to labour." These remarks are not difficult of application.

I may quote from the "Wise Saws and Modern Instances" of Sam Slick, the philosopher in motley, for another illustration:—

"You must be gentle, kind, and patient, but you must be firm; and when there is a fight for mastery, just show 'em it's best not to act foolish. Unless a crittur is too old, and too headstrong, it's a man's own fault if he can't manage to make 'em travel the road pleasantly.

"Well, some kick; don't put 'em in harness agin, that's all; they are apt to cut their little pasterns, and hurt your little gig. Some stop, and won't go. Treat 'em as I did a hoss once who wouldn't draw up hill. I set off from Hicknille once with a regular devil, to put her through her facin's at three o'clock in the mornin', and took books and cigars, and my dinner with me, to be ready for *in*action, as it was fine weather.

"Well, two miles from home was a high hill, and, as usual, my hoss stopped short, lay back in the breechin', and wouldn't budge an inch. She thought she was agoin' to have a regular-built frolic, and I intended she should. She whisked her tail, laid back her ears, and looked wicked, athinkin', the more you wallop me the more I won't go, and I'll upset you, and break a shaft if I can; but she didn't know what was in store for her.

"'Don't you hope you may get the chance?' says I.

"So I threw down the reins, lit my cigar, and began to read, and took no more notice of her than if she was in the stable. When twelve o'clock came, she looked round, as much as to say, if you aint agoin' to fight, will you make friends, old boy? Well, I took no notice, eat my dinner, and I turned to again, and began to read. Well, as the sun was goin' down, she began to get dreadful oneasy and fidgety, and so put one foot before the other; but I stopped her, and called out 'Whoh!' At last, she got very impatient; but I held on till she should take the word from me. Finally, I took up the reins, gave her a lick of the whip, and away she went up the hill, as if she smelt oats at the top of it; and to show her what a fool she was, I drove her twenty miles straight on eend afore I hauled up. She never baulked at a hill again."

To return. The question may be asked, What is to be done with the incorrigible? I think there can be but one answer—dismiss him. In this case there are, unfortunately, bad influences out of school, operating more powerfully, and counteracting but too successfully the good influences of discipline and instruction. Unless these could be removed, the prospect of reformation is hopeless; and, therefore, you are not only justified, but bound, out of regard for the welfare of the rest, at once to separate him from the school.

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EDUCATION PREFERABLE TO TRANSPORTATION.

In discussing the difficulties which have arisen in our system of juvenile transportation, the more important question of juvenile education has been irresistibly forced upon us. The question can be no longer evaded. The government is the national executive of the laws; and the same authority ought to protect the morals of the rising generation. Lord John Russell proposes that we should put our trust in a wholesome system of education; and that we should extend and improve it to the point that may support our trust. There can be no doubt of the superior policy of having schools instead of prisons, and teachers instead of police; and to carry this important principle into operation, measures of a compulsory character must be adopted. In the United States the citizens are abundantly careful of their personal liberties; yet there, in the chief state of all, Massachusetts, if a child is seen idling in the streets in school hours, every citizen has a right to take him by the hand and put him into the school of the township, explaining to the wondering Englishman that a certain intellectual and moral competency is required in that country of every citizen, the educational means being provided for all; and every citizen is entitled to see that his juvenile neighbour has his educational rights in preparation for his future duties. Thus is it in a state where there is no Pariah class; where parents at least profess to take care of their children, and the moral orphanhood of a whole multitude of infants is a thing undreamed of.

Whenever we have open day-schools for every wanderer, and industrial feeding schools for the destitute, and reformatory schools for the delinquent, and a sound education provided for all the children of the state, we may put our last gallows into the British Museum for a curiosity, and let our transportation system merge into a legend.

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ON THE STUDY OF EUCLID.

III.—THE FRAME OF MIND IN WHICH GEOMETRY SHOULD BE PURSUED—THE HABITS OF MIND WHICH THE PURSUIT ENGENDERS.

I AM now to give you a few words of advice as to the disposition of mind with which you should sit down to the study of geometry, and to notice some of the intellectual advantages which you have a right to expect from the time and attention devoted to the subject.

You have already seen what the preliminary conditions are which Euclid makes with you: he considers these to have been conceded, without the slightest qualification or reserve: as far as he is committed, he will take care that they are faithfully adhered to by himself, and he stipulates that they shall be equally binding upon you. They are fully and fairly placed before you in the *Definitions,* the *Postulates,* and the *Axioms.* In these matters he seems to assume a sort of magisterial authority, from which he allows of no appeal. If you refuse to subscribe to the conditions which he himself lays down, he, on his part, refuses to be your guide: he can conduct you through the rich domain you wish to explore upon no other terms: he is inflexible as to his preliminary arrangements for the journey; and he as good as tells you, as he told King Ptolemy of old, that "there is no royal road to geometry."

If, therefore, you have any notion still lingering in your mind, about a line, or a triangle, or a circle, &c., not strictly in accordance with what he authoritatively declares to be *the* notion, you must dismiss either it or *him.* If you have any scruples or misgivings about his postulates, or axioms, you must, in like manner, overcome them: you must examine them, and re-examine them, till you are fully convinced that the postulates are really conceivable operations, and that the axioms are really unquestionable truths; for, depend upon it, he will tie you down most rigidly to the *conditions,* and allow of no escape, no evasion, no qualification. It matters nothing to him by what process of mind you satisfy yourself of the truth of his axioms, nor by what mechanical contrivances you seek to give an outward representation of lines, triangles, and circles: you may use pen, ruler, compasses, or whatever you please, for your own individual convenience or assistance; but remember, that he himself takes no cognizance of these things. If, without any instrumental aid at all, and by mere freedom of hand, you were to sketch the outline of an inclosed figure, and make *that* the representation, to yourself, of a circle, Euclid would find no fault with you, provided only you still, in imagination, endowed it with the characteristics of the true circle that he had defined. You would find a carpenter, or a mason, much harder to please, in a matter of this kind, than you would find Euclid. If you have carefully read the two preceding articles, you will see that I am quite justified in making this statement; for you will have learned that Euclid is not concerned with the *representations,* but with the *things* themselves—the purely intellectual conceptions.

Taking it, then, as a settled matter, that you receive Euclid's definitions—that you *do* "grant" his postulates, and that you *do* fully acquiesce in the truth of his axioms, all preparatory ground is cleared; and you may proceed at once to the business proposed. And here, you are to observe, that both you and your author occupy different positions. Euclid at once, from this point, drops his authority as a master; you withdraw your submission as a docile and obedient pupil. What he *says,* you are to regard no longer—only what he *proves.* You are to exercise a vigilant watchfulness over every statement he makes, receiving just so much of it as you cannot help receiving, and no more. *Faith,* in anything he advances, is not to be thought of. Be as sceptical as you please—nay, as sceptical as you can. Euclid would not thank you for any gratuitous concession whatever; all he demands is, that you will honestly respect the preliminary articles of agreement; and, in spite of all your opposition, and of all your scepticism, he will *compel* you—however much against your wish—to do unqualified homage—not to *him*—but to the truths he propounds.

And this is the attitude of mind you are to assume in entering upon the propositions of Geometry. There must be no yielding to the dicta of a teacher—no intellectual obeisance to the authority of a great name. Every truth you acquire, you must *so* acquire as to feel and know it to be a truth, from your own perfect individual *conviction* that it is so. Your conviction must be so thoroughly inwrought and complete, that if a Newton, or even a greater than Newton, should attempt to controvert a truth thus secured, the effect of such an attempt upon your mind would be about the same as an endeavour to convince you that you are an inhabitant of the moon.

Now, I think that, from these unqualified statements, you may fairly make two inferences, well worthy of consideration. The first is, that even in this, our frail and erring state, there is offered to our notice a system of unadulterated and incontrovertible Truth, built up by purely human effort, and consolidated and rendered imperishable by purely human reason. The second inference is, that the reasoning process, by which such an intellectual structure has been reared, must surely be of the most faultless kind—no logical error can have been committed—no conceivable objection unanticipated, and no case of exception unprovided for.

These considerations alone seem to me amply sufficient to incline all who have the time and opportunity, to a diligent study of geometry, apart from all regard to practical applications. Only reflect for a moment upon the *habits of mind* which such study must necessarily foster, where they in any way exist, or *create* where they are wanting The frequent contemplation of *Truth* has a salutary and an ennobling influence. Next to Inspired Truth, the truths of pure science furnish the most exalted materials upon which the human mind can exercise its powers. He who is earnestly and *successfully* engaged in this exercise, comes, at length, to love truth for its own intrinsic excellence ; to be fascinated with its unadorned beauty ; and to entertain increased repugnance towards the deformities of falsehood. Habits of mind become formed and fixed from the natural effects of those trains of thought in which we most frequently indulge in early life ; and hence the study of geometry, and of the sciences which carry out its pure principles, have an important influence, even in a *moral* point of view. To secure the operation of this influence, is surely deserving an effort. The properties of geometrical figures may be matters of perfect indifference to us—we may take but little direct interest in what relates to triangles, and parallelograms, and circles ; but we cannot be indifferent to a truthful habit of mind; and though all the theorems of Euclid be forgotten, yet if *this* remain as an abiding result, how great will be the acquisition we shall have made!

But the *intellectual* advantages connected with the study of the "exact sciences," are even more certain and palpable than the *moral* advantages here alluded to. You cannot read a proposition of Euclid as it ought to be read—and indeed as it must be read, in order to fully understand it—without a concentration of attention more intense than most other subjects, out of mathematics, demand; and since, as noticed above, there must be no disposition to admit anything whatever, without the most complete conviction of its truth, a habit of scrutinizing evidence, and of distinguishing between plausibilities and proofs, is insensibly, but surely acquired. There is, perhaps, no faculty of the mind which in early life stands in more need of cultivation than the reasoning faculty; for every one reasons, or at least engages in what goes by the name of reasoning, so that man has been even defined to be "a reasoning animal." Locke says, "Would you have a man reason well—let him learn geometry;" that is to say, if to reason well be the only end in view—all the truths of Euclid being regarded as utterly valueless — still let geometry be studied. Yet geometry supplies no rules, it prescribes no directions for conducting a logical process; but, what is better, it places before us a collection of the most exquisite models. It teaches by example, not by precept; and no one, with proper attention, can fail to profit by its lessons.

You see, therefore, that Euclid is something more than a mere problem-book for the use of architects and surveyors: it is the most finished treatise on the "Art of Reasoning" that the world possesses; and it is chiefly as such that I am anxious to recommend to my young friends a careful study of its contents. It may fail to render you much direct professional service; but the mental discipline it furnishes will strengthen your judgment, improve your logic, give additional acuteness to your penetration, and, in fact, so enlarge and invigorate all the faculties of your mind, that you will be enabled to bring a higher degree of intellectual power to bear upon any pursuit in which you may earnestly engage. It is not the properties of geometrical figures that can do this: it is the reasonings by which they are established. The several stages at which you arrive, in your progress through Euclid, may present but few points of attraction; but you *must* be benefited by the invigorating influence of the journey.

Before concluding the present article, it may perhaps be as well, to prevent misunderstanding, that I should offer a remark or two in reference to a direction I have given you above—namely, that you should approach the demonstrations of Euclid in a sceptical spirit. It has been foolishly, and most unjustly, affirmed by some, that the study of pure science has a tendency to produce *general scepticism.* Now, all truths are harmonious; they have common features and common attractions, recommending themselves to our homage by the same dignified aspect and bearing. How can scientific truth ever be out of keeping with inspired truth? A religious sceptic is generally something more than a mere *neutral* as respects divine things: he is usually a *denier;* that is, he embraces a *negative proposition,* and acts upon it without proof! How does geometry sanction this? In Euclid there are negative propositions as well as affirmative ones: I recommend you, anterior to proof, to be equally sceptical as to *both.* In things out of geometry, geometrical demonstration is, of course, not to be had: it would be folly to look for it; yet, if in such things an affirmative be declared on the one hand, and a negative on the other, do you not think that the logic of geometry, as well as the logic of common sense, would incline us to *that,* in support of which *some* evidence was offered, rather than to that which had no such support at all?

But there are sceptics of a different stamp from the class noticed above; men of literary and philosophical habits, who do not content themselves with a "cold negation." They address themselves to the task of undermining the existing evidences for the truth of Christianity. Such a man was David Hume, a distinguished writer of the last century. He wrote an Essay to prove that *a miracle* never could have been performed, or, at least, that we have no reliable evidence of its performance. He laid down certain preliminary principles, and dressed his performance in the garb of *fair reasoning.* But Hume knew nothing of mathematics; and, in invading its province, he trod upon slippery ground—and *fell.* Those who *did* know something of the "exact sciences," betook themselves to the investigation; they started upon precisely the same principles as Hume did, without the assumption of a single additional particular, and they arrived, by a train of reasoning which it is impossible to disturb, at a conclusion *directly opposite to his.* Had Hume known but a little of mathematics, and had he revised his so-called *argument,* in the same sceptical spirit which I recommend to you, a regard for his own literary reputation merely would have precluded him from ever publishing to the world his "Essay on Miracles.*

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DR. BECKER'S SYSTEM OF GRAMMAR.

In Germany, Dr. Becker is distinguished even among his learned countrymen, not only as an eminent philologer, but as the author of a new system of grammar, based essentially on the connection between thoughts (notions or ideas) and words, and between Logic and discourse. These works are not entirely unknown in England; but, excepting to those who are engaged in studying or teaching the German language, they are known only to the few who are addicted to the study of philology. Becker's German Grammar for Englishmen is of course in the English language; but as it is a German Grammar, it is necessarily adapted only to that language, and the examples are consequently all German. It does, notwithstanding, afford a view of his system.

The second edition of this work appeared about nine years ago, edited by the younger Becker. The work however, which the writer wishes to epitomize for the benefit of those who do not read German, is Becker's "Deutsche Schul Grammatik," in which his system is practically exhibited. This work was followed by his "Ausfuhrliche

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* See "Babbage's Bridgewater Treatise"—Appendix. Also Young's Three Lectures on Mathematics.

Deutsche Grammatik," a work in which the principles developed in the German school-grammar are copiously detailed and explained. These two works bear to each other about the same relation, both in size and object, which Murray's two larger grammatical works bear to each other.

But as Dr. Becker's whole system is founded upon what he calls the organic structure of language, it was necessary to refer to another work of our author's, viz., his "Organismus der Sprache" ("the Organs of Language"), in which the author lays down his views of the nature of language in general as an organic product necessarily originating in the very constitution of man's innermost being,—an organism as essential for the development of his intellectual and spiritual nature, as his external members or limbs are necessary to the complete development of his physical or material being. The twelve earlier sections are filled up with the general subject, or the organism of language in general.

The writer has long been desirous that the linguists of England should be introduced to Dr. Becker's philological treatises. We have a translation of Bopp's "Comparative Grammar of the Indo-Germanic and Celtic Languages," while Becker and Gremin, whose researches into the ancient and modern Teutonic tongues have shed a lustre, not on the men alone, but on their country also, are still inaccessible to the great bulk of English scholars.

It is not intended to attempt a translation of all or either of the above-mentioned works of Dr. Becker's, nor to give a mere outline, nor a condensed summary of their contents; our object is to let the author himself state the scope of his work; explain its nature and objects; in fine, to suffer the learned German to introduce his own subject in his own way, reserving to ourselves the liberty of abbreviating both his reasonings and his facts wherever we think them rather abstruse or incapable of illustration in our own language.

As the first-mentioned work is the foundation of his strictly grammatical treatises, we shall proceed with our account of his "Organismus der Sprache" ("the Organism of Language"). The title will be explained most satisfactorily by the contents or substance of the work.

Language, he holds, is properly defined as the medium of communication between rational beings, as the means of conveying our ideas to others, the means of mutual interchange of thoughts, intentions, &c. The effect of external objects on our perceptive powers, our views of nature, &c., expressed in speech, are termed by Becker products of humanity; but speech is only possible through or by the instrumentality of the *organs of speech*—viz. the lips, the tongue, palate or throat, which are almost involuntarily and momentarily in exercise for this object. Language is an organic function, one of the functions of rational living beings, arising out of, or originating in, the nature of their being, and proceeding necessarily from their organic life. Man speaks because he thinks; and thought is the essential characteristic of rational beings. It is a general law of animate nature, that in it every activity is manifested in some materiality or outward visible or audible manner; and every spiritual or intellectual operation is manifested by a corporeal or physical act. By this law the intellectual or spiritual products of our minds, souls, or spirits, assume the physical or material nature of words, and thus are developed as the exponents of mental phenomena.

Language is nothing else but the material development of thought; and hence thought and speech are only one and the same phenemenon; the one is the complement as well as the exponent of the other. The object of language is not merely an interchange of thoughts for mutual aid, information, and supply of our necessities, &c.; it is the very sustenance of the intellectual and contemplative life. It is employed among savages, not alone for the satisfaction of external wants, but also to give expression to their passions, their griefs, their joys, their hopes, and their fears. Language is itself a necessary function of humanity; without it humanity would be incapable of self-development, for it needs not merely an instinctive intercourse, such as is adequate to the necessities of lower animals, but a social communion of ideas, a unity of individual mental activities, in order that the individual may possess the enlarged views of the many with whom he may enjoy the benefits of social intercourse.

Language is only possible by the presence and activity of two series of organs, viz.—1st, the organs of speech, whereby something is given or uttered; and 2nd, the organs of hearing, through which something is received or heard. Where either apparatus, or both of them, are wanting, speech is impossible.

The origin of the development of speech is a subject of great obscurity, yet it generally appears at the same period as that at which the traces of intellect and spirit begin to manifest themselves. Infants commence the first exercises of both these functions—viz., of desire, thought, and other intellectual operations, and of language, about the fifth month of their lives.

At an early period of life the child distinguishes objects from each other, and gives utterance to the feelings of gladness, delight, and the contrary. The babe does not speak as a means of getting its wants supplied, but it emits sounds as it exercises its other faculties for its own internal satisfaction. It has a pleasure in the utterance of loud hearty sounds; and these may usually be considered as the external manifestation, the measure of its inward mental development. In the first attempts of children to speak, all their words are monosyllabic, and mostly one word constitutes an entire sentence; but this word is always that on which the sense depends; it is the most material notion which is thus embodied by sound. Children are not so much the subjects of imitation as is often supposed. They are constantly hearing language, but they never appropriate nor employ any portion of it but such as they thoroughly comprehend, and which they can apply to the expression of their own feelings. They speedily learn the names and the activities of the objects within their own immediate reach or vision: but they never remember the names of abstract or invisible things, because they have in their own minds no idea corresponding to abstract or unseen realities. It deserves notice, that relational words—viz., such as convey the ideas of relations to persons or things, as pronouns, adverbs, prepositions, &c., are among the last words that children learn. The author proceeds to show, by the example of children who generally are talkative, and by that of insane persons, that the function of speech is more under the control of will than any other function is.

Sound, which is the material of which words are formed, is the product of vocal organs—lips, tongue, &c.; and sound is so intimately connected with mind, that all the modifications of which thoughts are susceptible can be adequately represented by modulations of the human voice. The organ of hearing is equally susceptible to the impressive nature of sound. The sounds of wailing and mirth convey to the hearer an unmistakable evidence of the mental condition of those by whom these sounds are uttered. Hence the author proceeds to show that spoken language is vitally and necessarily related to thought; not externally, materially, and arbitrarily, but internally, logically, and necessarily. It is as a function totally distinct from the signs which the dumb and deaf use in conversing with each other. As language proceeds essentially and necessarily from human life, from the constitution of man as a spiritual corporeal reality so it cannot be taught—it must be learned.

In the third and fourth sections the Doctor states that the real function of grammar is not to teach "how one should speak," but simply to relate "how one does speak," just as true natural philosophy points out to the student of physics the principles and processes whereby any organism (organized production), whether natural or artificial, is perfected or completed. Grammar also informs us what are the principles whereby men in general give expression or form to their inward emotions. This is called general grammar. The grammars of special or individual languages show how those general principles are modified by the usages of vocal organs prevalent in distinct nations.

In the fourth section the author shows the organic nature of speech; that language, being a product of organized, intelligent, and rational beings, is necessarily organic itself. He subsequently sets forth the necessary connection between thoughts and feelings on the one hand, and their external expression by audible sounds on the other. This he calls the logical and phonetic development of language.

The remainder of this section is filled up with proofs or evidences of the assimilation of the external world to the notions which we receive of outward, visible, tangible or audible things through the medium of our perceptive faculties—the forms which perception and notion assume, &c.

The fifth section embraces the logical and phonetic principles of language. Language is logically developed in the comparison of ideas or notions, and phonetically in relations of sounds. The type of phonetic development is connected with the laws of the organic sounding-apparatus (vocal organs) with the organic contrasts of the organs forming sound. The type of the logical development appears in the fact that language is the outward material expression of inward perception.

Here the author shows the relation between external objects and the internal power by which they are apprehended; and also that this latter power, perception, is organically developed in the mind. He also demonstrates how the impression received by perception is changed by the independent active power of the mind into notions and causes of mental activity, and how these ideas and notions are organic products of imagination.

The sixth section enters upon the relation of language to mental culture. Here he shows that language, unlike art or invention, is an organic necessary product of man's inner being; not like the latter, originating in a reflective mind, excited by external wants. He shows further the unity of language and intelligence, the relation of speech to civilization, and its production as a consequence of national culture.

The next section treats of the uniting of all specialities and individualities in language into one organic whole, as accomplished through that mutual relation which, as in all organic mutual relationships, is founded on relative differences. Here he goes on to state the differences between vowel sounds and vowels united with consonants,—mutes, liquids,—the organs of speech, the palate, the tongue, the lip—differences of ideas, notions, activity. and substance.

As in all natural things, says the author in his eighth section, so also in language, development is the result not of external combination but of internal increase. The most ingeniously constructed piece of mechanism does not possess a unity of such perfection or such an apparatus of distinct organs so perfectly adapted to the accomplishment of a common end, as natural objects, even the simplest, possess.

In the tenth section the author introduces this aphorism, viz.: *The idea of an organism comprehending the whole language, and interpenetrating all its individual parts, must be the leading idea of all grammatical investigations;* and it is the special duty of the *historians of language and of grammar* to trace out the manifold relations which this organism has assumed in the different periods of languages and dialects. In a very copious manner he shows the connection of grammar with historical investigations on language, and finally the relation between logic and grammar.

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SAYINGS OF WISE MEN.—No. I.

WITH OCCASIONAL ANECDOTAL ILLUSTRATIONS.

"And what of this new book, that the whole world make such a riot about?"—*Sterne.*

"Here are no forced expressions, no rack'd phrase,
No Babel compositions to amaze
The tortured reader——
* * * * * *
No obscene syllable that may compel
A blush from a chaste maid."—*Massinger.*

"Virtue, and that part of philosophy
Will I apply that treats of happiness,
By virtue specially to be achieved."
—*Taming of the Shrew.*

"If I have more to spin
The wheel shall go."—*Herbert.*

Before we continue *our* collection of Wise Sayings, we will place before the reader some curious matter indirectly connected with our subject—namely, the manner in which, to some extent, our ancestors compensated, in their households, for the want of such works as that in which we are now addressing the reader.

In former times, the nobility and gentry were in the habit of having their principal apartments decorated with sentences chiefly extracted from the Scriptures, and a few Greek and Latin authors.

Leckinfield Castle—one of the possessions of the Earls of Warwick—was thus adorned. In one room there was a dialogue, in thirty-two stanzas of four lines, between "The Parte Sensatyve" and "The Parte Intellectyve;" containing a poetical comparison between sensual and intellectual pleasures. In another room, there was a poem in thirty-two stanzas, of four lines; being a descant on harmony, as also on the manner of singing, and playing on most of the instruments then used. In another apartment, there were reflections on the family motto, in thirty distichs; the concluding distich was—

> " *Experaunce en Dieu,* in hymn is all:
> Be thou content, and thou art above Fortune's fall."

A fourth room contained a poetical dialogue, containing instructions for youth, in a hundred and forty-two lines. In a fifth room there were twenty-three stanzas. We give one specimen:—

> " To every tale geve thou no credens.
> Prove the cause, *or** thou gyve sentens.
> Agayn the right make no dyffens.
> So hast thou a clene consciens."

In the sixth and last apartment so furnished, there was "the counsel of Aristotle, which he gave to Alexander, King of Macedonia." It consisted of nine stanzas, of eight lines; take the last stanza but one:—

> "Punyshe moderately, and discretly correct,
> As well to mercy, as to justice havynge a respect;
> So shall ye have meryte for the punyshment,
> And cause the offender to be sory and penitent.
> If ye be movede with anger or hastynes,
> Pause in your mynde and your yre repres;
> Defer vengeance unto your anger asswagede be;
> So shall ye mynystre justice, and do dewe equyte."

Three of the apartments in Wiessill Castle were also adorned with poetical inscriptions. In the first, there was a poem of twenty-four stanzas, each containing seven lines; beginning thus:—

> " When it is tyme of cost and greate expens,
> Beware of waste and spende by measure:
> Who that outrageously makithe his dispens,
> Causythe his goods not long to endure."

Of the celebrated Anne Clifford, Countess of Pembroke, we are told that "she was not ignorant of knowledge in any kind which might make her conversation, not only useful and grave, but also pleasant and delightful; which, that she might the better do, she would frequently bring out of the rich storehouse of her memory things new and old, sentences or sayings of remark, which she had read or learned out of authors. And with these her walls, her bed, her hangings and furniture must be adorned, causing her servants to write them in papers, and her maids to pin them up, that she or they, in the time of their dressing, or as occasion served, might remember and make their descants on them. So that, though she had not many books in her chamber, yet it was dressed with the flowers of a library."

In the British Museum, there is a curious volume, containing drawings of about forty different tablets, on which sentences selected from ancient authors are inscribed, and which once ornamented the apartments of Sir Nicholas Bacon, the father of the famous philosopher. These sentences are in Latin, and the designs of the tablets afford some very fair specimens of the taste of the sixteenth century. They are contained in a dozen quarto pages, and are all richly coloured and gilt. On the first drawing is an inscription, informing us that they were "painted in the Lorde Keeper's Gallery at Gorhambury, being selected by him out of divers authors, and sent to the good Ladye Lumley at her desire."

A LIBEL ON THE LADIES.

The reason why so few marriages are happy is because young ladies spend their time in making nets, not in making cages. —*Swift.*

Of course this is not applicable to the ladies of the present day. We introduce it merely to show the state of society at the time when Swift wrote.

And we can only account for the following passage by Washington Irving, usually so amiable and tender-hearted, by supposing that he was troubled by a fit of indigestion when he penned it:—

"It is appalling to those who have not yet adventured into the holy state to see how soon the flame of romantic love burns out, or rather is quenched in matrimony, and how deplorable the passionate poetic lover declines into the phlegmatic, prosaic husband. I am inclined to attribute this very much to the defect just mentioned in the novels, which form so important a branch of study of our young ladies; and which teach them how to be heroines, but leave them totally at a loss when they come to be wives."

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* Before.

But, we pray thee, gentle reader, now to read this defence, in the words of Beaumont and Fletcher:—

"A woman's goodness, when she is a wife,
Lies much upon a man's desert; believe it, sir,
If there be fault in her, I'll pawn my life on't
'Twas first in him, if she were ever good."

We have thus given the libel, but we have also provided a powerful antidote.

Magnanimity. — "Magnanimity," says Rochefoucauld, "is well enough defined by its name; nevertheless, we may say that it is the good sense of pride, and the most noble way of earning praise." Several examples of this quality might be collected. Philip, King of Macedonia, was told that several calumnies had been industriously spread abroad respecting him by the Athenian orators. "It shall be my care, then," said he, "by my life and actions, to prove them liars." Being advised by some of his courtiers to banish one who had railed at him—"Let us first see," he replied, "whether I have given him occasion." Discovering, after due inquiry, that the accused had performed several meritorious actions for him without recompense, he at once acknowledged that the fault had been his own, and immediately ordered him a suitable reward.

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EDUCATION OF FARMERS.

Why the scientific knowledge of agriculture has advanced so slowly in this country would be an important inquiry. It is a fact that our productions are little more than one-half of what they should be, and yet we seem to be content to bide our time, and be satisfied with results, when accident or chance shall produce them, or when we shall be jostled from the "old way" by the coming generation.

More than seven hundred years before the Christian era, Isaiah prophetically speaks of a threshing-machine. "Behold, I will make thee a new sharp threshing instrument having teeth." And yet this intimation pointing out almost the very structure of the machine now in so common use, was not realised until the nineteenth century, and then received with a doubting opinion that well-nigh dampened the experiment. The merchant has carried his enterprise into every nook and corner of the known world—the learned have exerted their talents to the development and practical application of scientific principles, which has given to their class an enviable place in the estimation of mankind: the mechanic, availing himself of these developments of science, has given them form and shape to an extent which entitles them to the admiration of the world; while the farmer stands to gaze with mingled feelings of doubt and astonishment, that all the other pursuits of life whirl so rapidly past him.

What is the remedy for this admitted evil? We answer—the education of farmers' sons through the medium of agricultural schools. We mean schools to educate boys in the art and science of farming; and unless the farmers will zealously embrace this idea, and avail themselves of it, there is no hope that their condition can be otherwise improved, but by the lapse of time, and happening of accidental circumstances.

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Public Schools in Rural Districts. —The Committee of the Privy Council on Education, have recently issued a copy of minutes respecting grants for such schools as receive grants towards the expenses of the preceding year at the rate of 6s. per scholar in boys' schools and 5s. in girls' schools, if the number of scholars be under 50. Above 50 and under 100, the grants are 5s. for each boy and 4s. for each girl; and if the number of scholars be above 100, 4s. may be granted towards the expenses of the instruction of each boy and 3s. for each girl. With regard to the voluntary assessments towards the expenses of school-buildings, the Committee have resolved that whenever school-room is wanting in any parish under 5,000 inhabitants, and in case the owners and occupiers of property shall raise a sum equal to one-half of the estimated outlay for the erection of suitable premises, the Committee will grant one-half of the same outlay.

RATIONAL RECREATIONS.

ARITHMETIC.

I.

A gentleman dying left his executor a sum less than £2,000, to be divided between his relations in such a manner that his father and mother, son and grandson, brother and daughter, should receive a sum not less than £666 13s. 3d. Required the relationship, and the sum to be divided?

II.

If from six you take nine, and from nine
you take ten,
(You youths now the mystery explain);
And if fifty from forty be taken, there then
Shall just half a dozen remain.

III.

Supposing there are more persons in the world than any of them has hairs upon his head, it then necessarily follows that some two of them at least must have exactly the same number of hairs on their heads to a hair. Required the proof?

IV.

Place four 5's so that their sum shall be $6\frac{1}{2}$.

V.

Two thirds of six, if multiplied
By just one-fifth of seven,
Then what's the number that's descried
When product's fairly given?

VI.

Smith walking out, finds, on turning round, that Thompson is 400 yards behind him, desiring to overtake him; they each of them moved 200 yards with their faces towards each other in a direct line, yet were still 400 yards asunder. How could this be?

VII.

Come tell to me, what figures three,
When multiplied by four,
Make five exact (it is the fact),
This unto me explore.

VIII.

It is required to place four 2's in such a manner as to form four numbers in geometrical progression.

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EDUCATIONAL AND SCHOLASTIC MATTERS.

Government Education Measure.—This important national scheme appears to have been abandoned, at least for the present. Lord John Russell, on being lately pressed for information on the subject, announced to the House of Commons that he would not, in case of his motion for the second reading being successful, seek to carry it to its final stage during the present session of parliament. This we consider a virtual abandonment of the measure. But whatever may be the fate of national education, that of private education is likely to rest in the hands of those who have made it their profession; the Government having distinctly stated that their plan does not embrace the education of the middle but of the humble classes. "The scholastic profession," says the *Educational Times*, "have the deepest interest in whatever relates to education—just as every other profession regards its speciality. For any Government to say that it means to concern itself about the head and the tail, but intends to leave the body to its own resources, cannot be a very pleasing announcement; and becomes less agreeable when it is observed that the two extremities are each daily encroaching upon the trunk, threatening in no very remote time to absorb so much of it that it will be difficult to state where the body is; it may even leave a doubt whether it has any body at all. The great public schools and universities at one end are, it is evident, about to take a more popular character; while at the other end, the National Schools and Training Colleges are being made more liberal and attractive: the inevitable tendency is to render unnecessary the intermediate link—*the private schoolmaster*. Unfortunately the profession—for whom the fable of the bundle of sticks appears to have been written in vain—are either singularly short-sighted, or else singularly indifferent to their own interests."

University of Dublin.—The official report recently published by the Dublin University Commissioners is of considerable importance in an educational point of view. It appears, if their recommendations are carried into effect, that the royal statutes are to undergo a complete revision. The University Senate is to be abolished; no professorship is to be held by a senior fellow; the Board, with the consent of the visitors, is to vary the subjects prescribed for the fellowship examination, and to regulate the mode of examination. The statutable grounds of preference, in case of equality at the fellowship examination, is to be abolished; and the pupils' fees to be divided into four parts, one-fourth to go to the tutor, and the other three-fourths to a common fund, for the endowment of professorships, lectureships, and examinerships. The general obligation to enter holy orders, now imposed on fellows, is to be abolished, but at least four senior fellows are to be in holy orders. Ex-fellows to be eligible to the Regius Professorship of Divinity. A number of septennial divinity fellowships is to be established; and graduates of the Queen's University, recommended by the Bishops of the dioceses in which the respective Queen's Colleges are situate, are to have an opportunity of pursuing theological studies in the divinity school of Dublin University. The appointment to the Queen's Professorships of French and German, and of Spanish and Italian, are to be in the provost and senior fellows; and the study of one modern language, at least, to be made compulsory for the degree of B.A. Various other recommendations relating to the internal economy of the college are added. The following recommendations are the most important:—The exclusion of Roman Catholics from the professorships of anatomy, chemistry, and botany are to be repealed; and subjects of foreign states to be allowed to obtain degrees without taking any oaths or making any declarations. The Copyright Act is to be so modified as to give the library of Trinity College the same facilities as the British Museum for obtaining the books to which the college is entitled.

Queen's Colleges, Ireland.—Dr. Forbes, in his "Memorandums" of Ireland, makes the following judicious observations:—"Notwithstanding the great pains taken by the enlightened government which founded the Queen's Colleges, to meet every difficulty in regard to religious differences among the people of Ireland, it is well known that the Catholic clergy have taken up a very hostile position against them, and have, in so doing, greatly retarded their progress hitherto. It cannot be doubted, however, that an opposition founded on such unjustifiable and untenable grounds, so discreditable to the Catholic hierarchy of Ireland, and so utterly at variance with the enlighted spirit of the times, must gradually lessen and finally vanish. No religious or ecclesiastical authority, however potent or however strenuously exerted, can permanently maintain, in this epoch, what reason and the common sense of men in general declare to be wrong; more especially if that which is believed to be wrong is also felt to be injurious to men's most personal and dearest interests."

Worcester Diocesan Theological College.—A new training College for candidates for holy orders has been opened at Dunchurch, near Rugby. Graduates of Oxford and Cambridge will have to reside at least four terms, ending severally at the Ember weeks. Literates will be admissible on the special recommendation of a Bishop. The course of reading will embrace the critical study of the Holy Scriptures in the original languages, the Prayer-book, ecclesiastical history, and standard divines. The students will be instructed likewise in elocution, and in the composition of sermons.

All Saints' National Schools, Islington.—These schools, situated in Rodney Street North, Caledonian Road, were recently opened by the Bishop of London. The school-rooms are capable of accommodating 250 boys and 250 girls. There is a residence for the master, and the whole is erected on a freehold plot of land purchased from the Regent's Canal Company, for £254. The total cost is estimated at £2000, which sum has been already subscribed. The bishop addressed the assembled company, remarking that the want of education among a large proportion of the poor was becoming a public scandal.

Exercise Books.—In the last number of "Fraser's Magazine," there are some very suitable remarks, which we submit to the consideration of tutors, scholars, and editors:—"There are many extant English works which might be revived with great advantage to the student, if really competent editors would take them in hand. But even if we must have an entirely new list of exercise-books, the proper persons to furnish them are the masters of schools. There never was a time when a greater number of first-rate scholars were at the head of grammar schools in this country. If only half a dozen of them would write one exercise-book each, we should soon show to Germany and America how little we need their assistance in providing elementary books for our young students. That some such course must be adopted is clear, unless the older books are revived in a suitable form."

Education and Schools in the United States.—During the year 1851-2, the number of public schools in Massachusetts was 4056; the number of scholars was, in summer, 185,752, and in winter 199,183; the average attendance being respectively 136,309 in summer, and 152,645 in winter. The number of teachers, summer and winter, was 2454 males and 6456 females. The average length of schools was 7 months and 15 days, and the average wages of male teachers was 37 dollars 26 cents per month, and of females 15 dollars 36 cents. The amount of money raised by taxes for the support of schools, including only the wages of teachers, board, and fuel, was 910,216 dollars 40 cents. This is exclusive of 39,763 dollars 87 cents voluntarily contributed, and 25,858 dollars 25 cents, the income of school-funds belonging to towns or districts. The income of the state school fund distributed among the towns was 41,558 dollars 22 cents. Besides the public schools, there are 71 incorporated and 749 unincorporated academies and private schools in the state, with an average of 16,131 scholars. In 1841-2, the money raised for schools by tax was an average of 2 dollars 79 cents for every child in the state between four and sixteen; in 1851-2, the average was 4 dollars 49 cents for each child in the state between five and fifteen. In the appropriation of money raised by tax from 1841-2 to 1851-2 inclusive, the increase was 76 per cent., while the increase of population was only about 35 per cent. In 1841-2 the number of public schools was 3198; in 1851-2 the number had increased to 4056—27 per cent. The number of teachers and the average attendance has proportionably increased.

The American Schoolmaster and his Pupil.—"Joseph, where is Africa?" "On the map, sir." "I mean, Joseph, on what continent—the Eastern or Western continent?" "Well, the land of Africa is in the Eastern continent; but the people, sir, are all of 'em down South." "How do the African people live?" "By drawing." "Drawing what—water?" "No, sir, by drawing their breath." "Sit down, Joseph. Thomas, what is the equator?" "Why, sir, it is a horizontal pole running perpendicular through the imagination of astronomers and old geographers." "Go to your seat, Thomas. William Stiggs, what do you mean by an eclipse?" "An old racehorse, sir." "Silence. Next: Jack, what is an eclipse?" "An eclipse is a thing as appears when the moon gets on a bust, and runs against the sun; consequently the sun blacks the moon's face." "Class is dismissed!"

THE EDITOR AND HIS CORRESPONDENTS.

The "Family Tutor."—With the present number, agreeably to the announcement in our last Preface, we have issued the first sheet of a New Work on "British Plants and Structural Botany." It is intended to form a volume independently of the "Family Tutor," and thus a sheet of it will be published, from time to time, with our semi-monthly numbers, without any extra cost. This, in addition to the numerous and varied articles with which our regular pages will be enriched, cannot fail to recommend the "Family Tutor" to the scholastic profession, as well as to general patronage.

The Saracens and Turks.—Various correspondents have made inquiries respecting the origin and history of those once belligerent races—the present contest between Russia and Turkey, in all probability, exciting a spirit of curiosity on the subject. Of the Turks, we have already given some notices under "Lessons on National History." The Saracens (of whom J. C. Jones makes inquiries) were the early defenders of the Mahomedan faith, and distinguished themselves so early as 622, A.D., by their conquests and warlike spirit. In 632 they overthrew the Persian monarchy; and in 823 they had extended their empire over Egypt, Barbary, Spain, Sicily, Sardinia, Majorca, Minorca, &c., with many of the islands of the Archipelago. Amidst the first conquests of the Saracens, they had turned their eyes towards Jerusalem. According to the faith of the Mussulmans, Mahomet had been in the city of David and Solomon; and it was from Jerusalem that he set out to ascend into heaven in his nocturnal voyage. A short time after the death of the Prophet, the soldiers of Omar besieged it. The Christians, animated by despair, swore to defend the city. The siege lasted four months, each day being marked by sorties or attacks; the Saracens approaching the walls repeating the words of the Koran, "Let us enter into the holy land which God has promised us." After enduring all the miseries of a long siege, the inhabitants of Jerusalem at length surrendered to the Caliph Omar, who himself came into Palestine to receive the keys and the submission of the conquered city. In the twelfth century, their power began to wane, till at length it was comparatively annihilated by the Christians, the Tartars, and the Turks. As regards the etymology of the word, there have been various opinions. Perhaps its true derivation is from the Arabic *Sharkeyn* (the Eastern people), which was first corrupted into Σαρακηνοί by the Greeks, and thence into *Saraceni* by the Latin writers. The name occurs in Pliny (vi. 28); and it began to be used about the first century of the Christian era. It was then applied to the Bedouin Arabs who inhabited the countries between the Euphrates and the Tigris. In the course of time, it appears to have become the generic name of all the Arabian tribes who embraced the religion of Mahomet, and extended their conquests over the greater portions of Asia and Africa.

Æolian Harp. M. Merrell.—We can only recapitulate the substance of what we have already given. Partington, in his "Encyclopædia of Arts and Sciences," describes the instrument as usually consisting of a simple box of thin fibrous wood, to which are attached a number of fine catgut strings, sometimes as many as fifteen, of equal size and length, and, consequently, unisons, stretched on low bridges at each end. Its length is made to correspond with the size of the window or other aperture in which it is intended to be placed. Its width is about five or six inches, its depth two or three. It must be placed with the strings uppermost, under which is a circular opening in the centre, as in the belly of the guitar. When the wind blows athwart the strings, it produces the effect of a choir of music in the air, sweetly mingling all the harmonic notes, and swelling or diminishing the sounds according to the strength or weakness of the blast. A more recent Æolian harp, invented by Mr. Crossthwaite, has no sounding board, but consists merely of a number of strings extended between two deal boards.

Example of Governesses. G.—Let the child see that all you do proceeds from a sense of duty, as well as a principle of love; let her *feel* the presence of an immediate and higher supremacy of mind and divine power ruling in *your* actions, and she cannot but respect you the more for your strictness, while she will not love you the less for your discipline; and the continual realization of this divine presence in your own breast is calculated, above all others, to humble yet sustain, strengthening the good, repressing the evil, and endowing your instructions with a force and an efficiency they would never otherwise attain.

Golden Age of the Latin Writers. George Williams.—The golden age begins at the time of the second Punic war, and extends to the latter end of the reign of Augustus; extending from the 514th to the 767th year after the foundation of Rome, or the 14th year of our Lord.

NATURAL PHILOSOPHY.

Second Division.

PROPERTIES OF LIGHT.—Optics.

CHAPTER XLI.

UNDULATORY THEORY OF LIGHT.

Two Theories of Light—Applications of the Corpuscular Theory—Undulatory Theory—Length of Waves is the cause of Colour—Determination of the Periods of Vibration—Interference of Light—Explanations of Newton's Rings, and Colours of thin Plates—Diffraction of Light.

It has been stated that there are two different theories respecting the nature of light—the corpuscular and the undulatory. In accounting for the facts in relation to the production of colours, it is assumed that, in the former, there are various particles of luminous matter answering to the various colours of the rays, and which, either alone or by their admixture, give rise to the different tints we see. In white light they all exist, and are separated from one another by the prism, because of an attractive force which such a transparent body exerts; and that attractive force being unequal for the different colour-giving particles, difference of refrangibility results. The colours of natural objects on this theory are explained by supposing that some of the colour-giving particles are reflected or transmitted, and others stifled or stopped by the body on which they fall. The phenomena of reflection by polished surfaces are therefore reduced to the impact of elastic bodies; and in the same way that a ball is repelled from a wall against which it is thrown, so these little particles are repelled, making their angle of reflexion equal to their angle of incidence. But while there are many of the phenomena of light, such as reflexion, refraction, dispersion, and colouration, which can be accounted for on these principles, there are others which the emanation or corpuscular theory cannot meet. These are, however, explained in a simple and beautiful manner by the other theory.

The undulatory theory rests upon the fact that there exists throughout the universe an elastic medium called THE ETHER, in which vibratory movements can be established very much after the manner that sounds arise in the air. Whatever, therefore, has been said in Chapter xxxi., &c., respecting the mechanism and general principles of undulatory movements, applies here. Waves in the ether are reflected, and made to converge or diverge on the same principles that analogous results take place for waves upon water or sounds in the air. It will have been observed already that the reflexions of undulations from plane, spherical, elliptic, or parabolic surfaces, as given in Chapter xxxi., are identically the same as those which we have described for light in Chapter xxxvi.

From the phenomena of sound we can draw analogies which illustrate, in a beautiful manner, the phenomena of light: for, as the different notes of the gamut arise from undulations of greater or less frequency, so do the colours of light arise from similar modifications in the vibrations of the ether. Those vibrations that are most rapid impress our eyes with the sensation of violet, and those that are slower with the sensation of red. The different colours of light are, therefore, analogous to the different notes of sound.

In Chapter xxxii. it was shown how the frequency of vibration, which could give rise to any musical note, might be determined, and it appeared that the ear could detect vibrations, as sound through a range commencing with 15 and reaching as far as 48,000 in a second. The frequency of vibration in the ether required for the production of any colour has also been determined, and the lengths of the waves corresponding. The following table gives these results. The inch being supposed to be divided into ten millions of equal parts, of those parts the wave lengths are :—

For Red light	256
Orange ,,	240
Yellow ,,	227
Green ,,	211
Blue ,,	196
Indigo ,,	185
Violet ,,	174

More recent investigations have proved the remarkable fact, that the length of the most refrangible violet wave being taken as one, that of the least refrangible red will be equal to two, and the most brilliant part of the yellow one and a half.

Knowing the length of a wave in the ether required for the production of any particular colour of light, and the rate of propagation through the ether, which is 195,000 miles in a second, we obtain the number of vibrations executed in one second, by dividing the latter by the former.

From this it appears that if a single second of time be divided into one million of equal parts, a wave of red light vibrates 458 millions of times in that short interval, and a wave of violet light 727 millions of times.

Further, whatever has been said in Chapter XXXI., in reference to the interference of waves, must necessarily, on this theory, apply to light. Indeed, it was the beautiful manner in which some of the most incomprehensible facts in optics were thus explained, that has led to its almost universal adoption in modern times. That light added to light should produce darkness, seems to be entirely beyond explanation on the corpuscular theory; but it is as direct a consequence of the undulatory, as that sound added to sound may produce silence.

From a lucid point, *p*, Fig. 250, let rays of light fall upon a double prism, *m n*, the angle of which, at C, is very obtuse. From what has been said respecting the multiplying-glass (Chapter XXXVII.), it appears that an eye applied at *a* would see the point *p* double, as at *p'* and *p''*. Between these images there is also perceived a number of bright and dark lines perpendicular to a line joining *p'* and *p''*. On covering one half the prism the lines disappear, and only one image is seen.

This alternation of light and darkness is caused by ethereal waves from the points *p'* and *p''* crossing one another, and giving rise to interference. If, therefore, with those points as centres, we draw circular arcs, 0, 1, 2, 3, 4, &c., these may represent waves, the alternate lines between them being half waves. It will be perceived that wherever two whole waves or two half waves encounter, they mutually increase each other's effect; but if the intersection takes place at points where the vibrations are in opposite directions, interference, and, therefore, a total absence of light results, as is marked in the figure by the large dots.

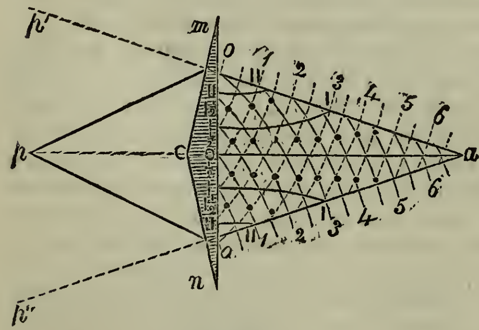

Fig. 250.

Wherever, therefore, rays of light are arranged so as to encounter one another in opposite phases of vibration, interference takes place. Thus if we take a convex lens, of very long focus, and press it upon a flat glass by means of screws, Fig. 251, at the point of contact, when we inspect the instrument by reflected light, a black spot will be seen, surrounded alternately by light and dark rings. These pass under the name of Newton's coloured rings. When the light is homogeneous the dark rings are black, and the coloured ones of the tint which is employed; but when it is common white light the central black spot is surrounded by a series of colours. When the instrument is inspected by transmitted light, the colours are all complementary, and the central spot is of course white. These rings arise from the interference of the rays reflected from the anterior and posterior boundaries between the two glasses. The colours of soap-bubbles and thin plates of gypsum, are referable to the same cause.

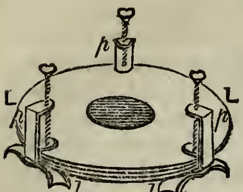

Fig. 521.

By the diffraction of light is meant its deviation from the rectilinear path, as it passes by the edges of bodies or through apertures. It arises from the circumstance that when ethereal, or, indeed, any kind of waves, impinge on a solid body, they give rise to new undulations, originating at the place of impact, and often producing interference. Thus, if a diverging beam of light passes through an aperture, *a b*, Fig. 252, in a plate of metal, an eye placed beyond will discover a series of light and dark fringes. The cause of these has already been explained in Chapter XXXI., in which it was shown that from the points *a* and *b* new systems of undulations arise, which interfere with one another, and also with the original waves.

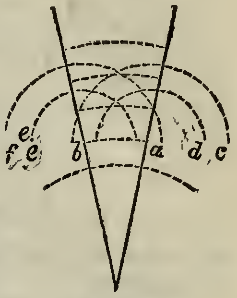

Fig. 252.

CHAPTER XLII.

OF POLARIZED LIGHT.

Peculiarity of Polarized Light—Illustrated by the Tourmaline—Polarization by Reflexion—General Law of Polarization—Positions of no Reflexion—Plane of Polarization.

When a ray of common light is allowed to fall on the surface of a piece of glass, it can be equally reflected by the glass upward, downward, or laterally.

If such a ray falls upon a glass plate at an angle of 56°, and is received upon a second similar plate at a similar angle, it will be found to have obtained new properties. In some positions it can be reflected as before; in others it cannot. On examination it is discovered that these positions are at right angles to one another.

Again: if a ray of light be caused to pass through a plate of *Tourmaline*, *c d*, Fig. 253, in the direction *a b*, and be received upon a second plate, placed symmetrically with the first, it passes through both without difficulty. But if the second plate be turned a quarter round, as at *g h*, the light is totally cut off.

Considering these results, it therefore appears that we can impress upon a ray of light new properties by certain processes, and that the peculiarity consists in giving it different properties on different sides. Such a ray, therefore, is spoken of as a ray of polarized light.*

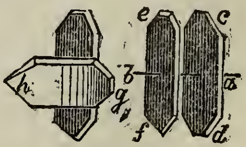

Fig. 253.

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* Dr. Pareira, in his "Lectures on the Polarization of Light," delivered before the Pharmaceutical Society of London, contrasts some of the distinguishing characteristics of common and polarized light, as follows:—

A RAY OF COMMON LIGHT	A RAY OF POLARIZED LIGHT
1. Is capable of *reflection* at oblique angles of incidence, in every position of the reflector.	1. Is capable of *reflection* at oblique angles of incidence, in *certain positions only* of the reflector.
2. Penetrates a plate of *tourmaline* (cut parallel to the axis of the crystal) in every position of the plate.	2. Penetrates a plate of *tourmaline* (cut parallel to the axis of the crystal) in certain positions of the plate, but in others is wholly intercepted.
3. Penetrates *a bundle of parallel glass plates* in every position of the bundle.	3. Penetrates a *bundle of parallel glass plates* in certain positions of the bundle.
4. Suffers *double refraction* by Iceland spar, in every direction, except that of the axis of the crystal.	4. Does not suffer *double refraction* by Iceland spar in every direction, except that of the axis of the crystal. In certain positions it suffers single refraction only.

A reference to the second column will at once explain the question, "*What is polarized light?*"—Ed

When light is polarized by reflexion, the effect is only completely produced at a certain angle of incidence, which therefore passes under the name of the angle of maximum polarization. It takes place when the reflected ray makes, with the refracted ray, an angle of 90°. Thus let A B, Fig. 254, be a plate of glass, *a b* an incident ray, which, at *b*, is partly reflected along *b c*, and partly refracted along *b e*, emerging therefrom at *e d*. Now maximum polarization ensues when *c b e* is a right angle, from which it follows that the polarizing power is connected with the refractive, the law being that "the index of refraction is the tangent of the angle of polarization."

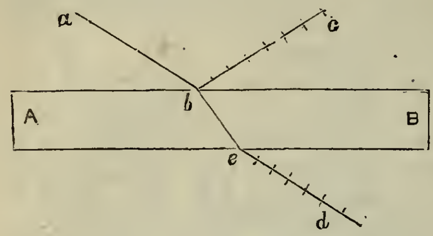

Fig. 254.

Let A B, Fig. 255, be a plate of glass, on which a ray of light, *a b*, falls, and after polarization is reflected along *b c*; at *c* let it be received on a second plate, C D, similar to the former, and capable of revolving on *c b*, as it were on an axis. Let us now examine in what positions of this plate the polarized ray, *b c*, can be reflected, and in what it cannot.

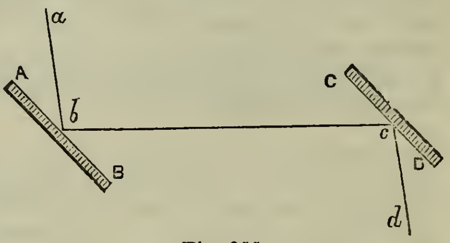

Fig. 255.

Experiment at once shows that when the plane of reflexion of the first mirror coincides with the plane of reflexion of the second, the polarized ray undergoes reflexion;—but if they are at right angles to one another, it is no longer reflected. To make this clear, let *a b*, Fig 256, be the first mirror, and *c d* the second, so arranged as to present their edges, as seen depicted on this page. Again: let *e f* be the first, and *g h* the second, now turned half-way round, but still presenting its edge; in both those positions, the planes of incidence and reflexion of both the mirrors coinciding, the ray polarized by *a b* or *e f* will be reflected. But if, as in *i k*, the second mirror, *l*, is turned so as to present its face, or, as in *m n*, it is turned at *o*, so as to present its back, in these cases, the planes of incidence and reflexion of the two mirrors being at right angles, the polarized ray can no longer be reflected. We have, therefore, two positions in which reflexion is possible, and two in which it is impossible, and these are at right angles to one another. By the *plane of polarization* we mean the plane in which the ray can be completely reflected from the second mirror.

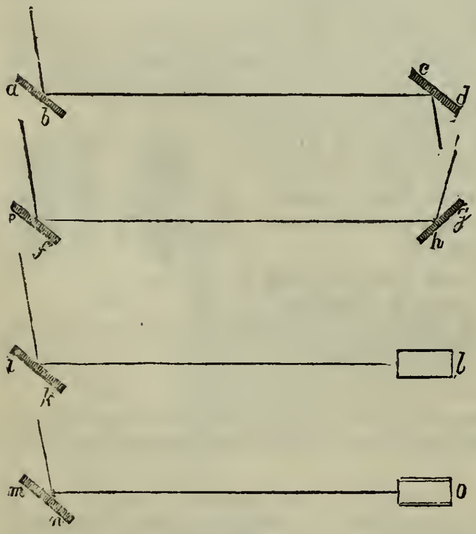

Fig. 256.

When a ray of light falls on the surface of a transparent medium, it is divided into two portions, as has already been said, one of these being reflected, and the other refracted. On examination, both these rays are found to be polarized; but they are polarized in opposite ways, or, rather, the plane of polarization of the refracted is at right angles to the plane of polarization of the reflected ray.

INORGANIC CHEMISTRY.*

XV. POTASSIUM.

Sulphate of Potash, $KO\ SO_3$, Equiv. 87·28. —This salt is usually prepared by neutralizing the residue of the nitric process, and is also procured by saturating a concentrated solution of potash by strong sulphuric acid, added drop by drop. It is an anhydrous, well crystallized salt, which decrepitates with heat, and has a density of 2·4. It requires 100 parts of water to dissolve 8·36 parts of this salt at 32°, and 0·096 parts more of the salt dissolve for every degree above that.

Bisulphate of Potash, or *Hydrate of Bisulphate* (sulphate of water and potash), $KO, SO_3 + HO, SO_3$, Equiv. 136·37.—This salt is obtained by decomposing nitrate of potassa by two equivalents of oil of vitriol, in the process for nitric acid. It cools into a white crystalline mass at 386°·6, which is very soluble in water, with partial decomposition. It is dimorphous in crystalline form, one of its figures being identical with crystallized sulphur. The solution is strongly acid, and acts on bases nearly as powerfully as if potash were not present.

Sesquisulphate of Potash, $2KO, SO_3 + HO, SO_3$.—This salt is obtained from the nitric acid residue, in long silky needles, which resemble asbestus. They cover the previous salt, after long standing, with a beautiful vegetation or efflorescence.

Nitrate of Potassa; Saltpetre; Nitre; KO, NO_5, Equiv. 101·25.—This important salt is a natural product in the hot and dry regions of India and South America, being formed by the gradual decomposition of animal matters in the soil. It is also formed artificially by heaping together beds of old mortar, earth, dung, and other animal matters, and occasionally wetting the mass with fermenting urine. In some of the caverns in Kentucky, the soil on the floors becomes strongly impregnated with nitrate of lime, which is decomposed by wood ashes, and yields nitrate of potassa. In all these cases, the nitre is obtained by lixiviating the nitrous earth with water, evaporating and crystallizing the solution, redissolving and crystallizing a second time, until the salt is obtained pure.

Properties.—Nitre crystallizes in long six-sided prisms, with dihedral summits, derived from the right rhombic prism; is anhydrous, and fusible at a heat under redness. It is unaltered in the air, and insoluble in alcohol, but dissolves in about 3 parts of water at 60°. In hot water it is much more soluble, 100 parts of water at 206°·6, dissolving 236 parts of the salt. Its solution has a cooling taste and antiseptic properties.

The great quantity of oxygen contained in nitre, and the ease with which it parts with it, render it a valuable agent. It is the chief constituent of gunpowder, imparting oxygen to the carbon and sulphur in that compound, to form with explosive energy those gases which are generated by the combustion of the materials. It is also much used in all pyrotechnic mixtures, as well as to deflagrate and scorify metals.

Nirate of potassa has been much used in England as a manure, and, as already mentioned, is the source of the best nitric acid. It is also employed to yield oxygen gas.

Chlorate of Potash, KO, ClO_5, Equiv. 122·60.—This is the salt already named as the best source of pure oxygen gas, of which it yields a great quantity by heat. It is formed by passing chlorine gas through a strong solution of carbonate of potash, chlorate of potash and chloride of potassium being formed, the chlorate being easily crystallized out by its less solubility than the chloride of potassium. The reaction is between $6KO,CO_2 + Cl + 5KCl = KO, ClO_5$.

Properties.—Chlorate of potash crytallizes in flat tables referable to the oblique rhombic prism, and has a pearly lustre. In cold water (30°) it is very little soluble, and 100 parts of water at 60° dissolve only 6 parts of the salt. Its taste is cooling and disagreeable, resembling nitre. It fuses below redness; oxygen is given off, and chloride of potassium left behind.

With combustible bodies its action is more energetic than that of nitre. With sulphur and charcoal it forms a compound that explodes by friction, and was formerly much used in the manufacture of lucifer matches. With sulphur alone, it detonates powerfully when wrapped in a paper and struck by a hammer. With phosphorus its reaction is extremely violent; a deafening explosion follows the slightest compression of the ingredients, and burning phosphorous is projected in all directions.

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* Resumed from page 24.

All attempts to form a gunpowder of chlorate of potash have failed, the action of the mixture being so violent as to rend asunder the arms employed. A mixture of sugar and chlorate of potash is instantly inflamed by a drop of sulphuric acid.

XVI. SODIUM.

Equivalent, 23·27. *Symbol*, Na. (*Natrium.*), *Density*, 972.

Sodium was discovered by Davy soon after the discovery of potassium, and in the same way. It is now prepared by a process quite similar to that already described for potassium, the carbonate of soda being used in place of carbonate of potassa.

This metal forms more than 40 parts in 100 of common salt, and is also frequent in various combinations in the mineral kingdom. The ashes of sea-plants afford, in place of the carbonate of potash of land-plants, crude carbonate of soda.

Sodium is a white metal, with a silvery brilliancy, and much resembles potassium in its general properties. Its density is 972, and it melts at 194°. At common temperature it is much harder than potassium, but is easily moulded in the fingers. It does not inflame on cold water, but moves about rapidly in a brilliant sphere, until it is all consumed. It may be alloyed with potassium by simple pressure, and is then inflamed on water, or alone on hot water, burning with a bright yellow light, characteristic of sodium. The same colour is seen when a piece of soda-glass, or any mineral containing soda, is held in the flame of the blow-pipe; the flame is instantly tinged yellow. Exposed to the air, sodium soon falls to a white powder of oxide of sodium.

The compounds of sodium are so similar to those of potassium, that we can pass them with a brief notice.

The Oxide of Sodium, NaO, Equiv. No. 31·27, is formed by decomposing the carbonate by the same means employed to form the caustic potash. It is a strong alkali, and very caustic. All its salts are soluble, by which it is distinguished from potash, whose chloride forms a sparingly soluble compound with chloride of platinum.

Chloride of Sodium; Sea Salt; Common Salt; NaCl, 58·68.—This familiar and abundant salt is too well known to need much description. It is formed when sodium burns in chlorine gas, as well as when soda or its carbonate is neutralized by hydrochloric acid. Common salt forms about 27 of every 1000 parts of sea-water, and in warm climates, especially in the West Indies, sea-water is evaporated in large quantities by the sun's heat, to obtain salt. Numerous saline springs are found in New York, Ohio, Kentucky, and other places in America, which afford vast quantities of salt by evaporation. The brine springs in Onondaga county, New York, are among the most valuable, and have been worked since 1789. This water contains one-seventh part of dry salt.

Common Salt crystallizes in cubes, which are anhydrous, and crackle or decrepitate when heated. It requires 2·7 parts of water for its solution, and is equally soluble in hot and cold water. Its density is 2·557, and in pure alcohol it is scarcely at all soluble. It fuses at redness, and sublimes in vapour at a higher temperature. It is employed for this reason to glaze earthenware, since its vapour is decomposed by the oxide of iron of the clay, chloride of iron being driven off, while soda unites with the silica of the clay to form the glaze.

The Bromide and *Iodide* of sodium resemble the corresponding compounds of potassium, and like them crystallize in cubes.

Carbonate of Soda is manufactured on a very great scale from common salt, and is found nearly pure in the arts. It crystallizes in oblique rhombic prisms, with ten atoms of water of crystallisation, ($NaO,CO_2 + 10HO$.) This salt is sometimes found native. The common form of carbonate of soda is a dry powder, called *soda ash*, which is an impure mixture of chloride, sulphate, &c. The pure salt has 58·58 per cent of soda, and 41·42 of carbonic acid. Carbonate of soda dissolves in about five parts of water, and the solution has a disagreeable alkaline taste.

Bicarbonate of Soda, $HO,CO_2 + NaO,CO_2$, Equiv. 84·27.—This salt is formed when carbonic acid is passed through a saturated solution of the neutral carbonate. It is deposited in a dry white powder, which requires thirteen times its weight of cold water to dissolve it. Its taste is alkaline, but much less disagreeable than the pure carbonate. It is much used in medicine and in domestic economy.

This salt is thrown down as a granular precipitate, when bicarbonate of ammonia is added in fine powder to a solution of an equal weight of common salt.

The sesquicarbonate of Soda (*trona*), ($2NaO + 3CO_2 + 4HO$), occurs in nature, being found in Africa and South America. It is little soluble, and unalterable in the air, and crystallises in right rhomboidal prisms.

Sulphate of Soda, Glauber's Salt, $NaOSO_3 + 10HO$, Equiv. 71·36 + 90.—This salt is the result of the hydrochloric acid process, and is also found native, and in solution in natural waters. It fuses by heat in its own water of crystallisation, and loses its water (effloresces) in dry air, and falls into a white powder. Water dissolves half its own weight of sulphate of soda at 91°, but only 42·65 parts at the boiling temperature.

A saturated solution may be cooled under a film of oil, or in a vessel corked tight while hot; and when it is cold no crystals will be deposited until the air strikes the surface, or a small crystal is dropped into the solution, when the whole mass instantly becomes solid. This salt is much used in medicine as an aperient.

The great use of sulphate of soda is in forming *soda ash,* or crude carbonate of soda, for the use of glass-makers and soap-boilers.

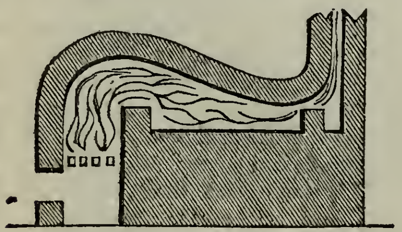

Fig. 7.

For this purpose the sulphate is strongly heated in a reverberatory furnace, mixed with charcoal or coke, and carbonate of lime. The sulphate is decomposed, sulphuret of calcium and carbonate of soda being formed; the latter is dissolved out by hot water, and purified by crystallisation.

Nitrate of Soda, Soda Saltpetre, NaO,NO_5.—This salt is found in India and South America, where extensive plains are covered by it, as at Tarapaca in Chili, and Iquique. It resembles nitrate of potassa, but cannot be used to replace that salt in gunpowder, on account of its strong disposition to attract water from the air and grow damp. It is generally employed, however, in making nitric acid, and also as a fertiliser in agriculture.

This is a white salt, crystallising in rhombs, specific gravity 2·09, very soluble, with a cooling taste, and deflagrates on burning coals with a strong yellow light.

The phosphates of soda are a very interesting and important class of salts, the study of which has done much to advance our knowledge of theoretical chemistry. We will mention five phosphates of soda, three tribasic, one bibasic, and one monobasic phosphate.

Phosphate of Soda.—Common Tribasic Phosphate, $2NaOHO,PO_5+24HO$.—This beautiful salt is prepared by precipitating the acid phosphate of lime, with a slight excess of carbonate of soda. It crystallises in oblique rhombic prisms, which are efflorescent. The crystals dissolve in four parts of cold water, and undergo the aqueous fusion when heated. The salt has a pleasant saline taste, and is purgative; its solution is alkaline to test-paper.

A *second tribasic phosphate,* sometimes called subphosphate, $3NaO, PO_5+24HO$, is obtained by adding solution of caustic soda to the preceding salt. The crystals are slender six-sided prisms, soluble in five parts of cold water. It is decomposed by acids, even the carbonic, but suffers no change by heat, except the loss of its water of crystallisation. Its solution is strongly alkaline.

A *third tribasic phosphate,* often called superphosphate or biphosphate, $NaO,2HO, PO_5+2HO$, may be obtained by adding phosphoric acid to the ordinary phosphate, until it ceases to precipitate chloride of barium, and exposing the concentrated solution to cold. The crystals are prismatic, very soluble, and have an acid reaction. When strongly heated, the salt becomes changed into monobasic phosphate of soda.

Microcosmic Salt, or *Phosphate of Soda and Ammonia* (HO,NH_4O,NaO,PO_5+8HO) is much used in blow-pipe operations as a flux. It is formed by dissolving with a gentle heat, 1 part of chloride of ammonium and 6 or 7 parts of phosphate of soda, in 2 of water. Chloride of sodium is formed, and the microcosmic salt crystallises out in rhombic prisms, which lose 8HO by heat.

Bibasic Phosphate of Soda, Pyrophosphate of Soda, $2NaO, PO_5+10HO$.—Prepared by strongly heating common phosphate of soda, dissolving the residue in water, and re-crystallising. The crystals are very brilliant, permanent in the air, and less soluble than the original phosphate; their solution is alkaline. A bibasic phosphate, containing an equivalent of basic water, has been obtained; it does not, however, crystallise.

Monobasic Phosphate of Soda, Metaphosphate of Soda, NaO, PO_5.—Obtained by heating either the acid tribasic phosphate, or microcosmic salt. It is a transparent, glassy substance, fusible at a dull red-heat, deliquescent, and very soluble in water. It refuses to crystallise, and dries up in a gum-like mass.

Borax; Biborate of Soda; $NaO, 2BO_3+10HO$.—Borax crystallises in right rhomboidal prisms, which are soluble in 15 or 16 parts of water; the solution has an alkaline reaction and sweetish alkaline taste. It loses its water by heat, and being very fusible, is much used in metallurgic processes and as a blowpipe re-agent. It is entirely procured from natural sources of boracic acid already mentioned, and from the waters of several lakes in Thibet which contain it.

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PUBLIC GRAMMAR SCHOOLS.

THE HIGH SCHOOL, BIRMINGHAM.

It is our intention occasionally to introduce to the notice of our readers some of the principal Grammar Schools of the kingdom (especially those of recent erection) which may be deserving of public attention from the peculiarities of their architecture, or worthy of general interest from the educational advantages they present. Among these we have selected "King Edward's Grammar School," Birmingham, commonly termed "The High School."

The foundation of this school is one of the many which date their commencement in the reign of Edward VI. The original building was displaced by a second one in 1707; and this becoming dilapidated, the governors, in 1834, resolved to employ Mr. Barry to construct the present edifice. He adopted the middle age Gothic or Elizabethan style of architecture, which belongs to the same general style that has since been employed by him in the erection of the new Houses of Parliament. The building presents a frontage of about 174 feet. Its depth is 127 feet, and height 60. There are seven ranges of flattish windows in front, with the accompanying buttresses, pinnacles, crowns, crosses, &c.; while there are bolder bay-windows at each extremity. The elaborate carvings which present themselves are of Derbyshire stone, and impart to the whole edifice a very enriched appearance. The interior is fitted up with all the requirements of a large school, having a spacious room for a library, and excellent accommodation for the masters. The entire building is said to have cost no less than £40,000.

The school supplies first-rate instruction in classics, mathematics, modern languages, and every branch of useful education, to the sons of all residents, at a very cheap rate, agreeable to the plan introduced into public schools by Dr. Arnold. The salary of the head master is £400 a-year, with a residence, and the privilege of boarding eighteen pupils. The second master has £300 a-year, and the under master and ushers are also liberally paid. These appointments have secured a succession of competent masters, and cannot fail to produce a permanent and favourable change in the character of young Birmingham; for the inhabitants of manufacturing towns are apt to become mere Plutocracies, in which (next to wealth) ignorance and assumption are the principal qualifications.

Besides the High School, there are four other schools supported out of King Edward VI.'s foundation funds, where reading, writing, and arithmetic are taught. The funds on which these establishments are supported arise from lands in the neighbourhood, which originally produced only £21 a year, and were part of the estates of the Guild of the "Holy Cross." After being occupied first as fields and then as gardens, the rise of manufactures, and extension of the town of Birmingham, converted a great portion into building land. The present revenue amounts to about £12,000 per annum, and is likely to be still further increased.

KING EDWARD'S GRAMMAR SCHOOL, BIRMINGHAM.

LESSONS IN FRENCH.

THE PRONOUN.

Of the Objective Pronouns It *and* Them (*speaking of things*), *when they are preceded in French by any other Preposition than* de *and* à.—Whenever the objective pronouns *it* and *them* (speaking of things) are preceded in French by any preposition other than *à* and *de*, it should be remarked whether the nouns of things to which these pronouns relate are personified or not; if personified, they are expressed in French by the corresponding objective pronouns relating to persons, *lui, elle, eux, elles, leur*; if not personified, the sentence should be modified so as to dispense with the pronouns altogether, or the construction should be altered so as to admit of these pronouns and their prepositions being rendered by *y* or *en*.

A noun of things is said to be personified, when the thing represented by that noun is made to act or to feel as a person would, or to possess qualities which belong only to persons. The following sentences will illustrate these several cases :—

"Mountains are frequented on account of the air one breathes on them; how many people are indebted to them for the recovery of their health!" In the first part of this sentence, the noun *mountains* is not personified; *on them*, therefore, cannot be expressed literally; the English idea should be modified, and *there* used instead of *on them*, and expressed by *y*, placed before the verb *breathes;* in the second proposition, on the contrary, the noun *mountains* is personified, for a person, or God alone, and not a thing, has the power to confer a benefit so as to create a debt of gratitude in the heart of man; *to them* should, then, be expressed by *leur*, a pronoun of person placed before the verb, and the whole sentence rendered as follows :—"Les *montagnes* sont fréquentées à cause de l'air qu'on *y* respire; combien de gens *leur* doivent le rétablissement de leur santé."

"War brings in its train numberless evils." War is a state of things which, properly speaking, has not the faculty of bringing things in its train; it is man, who, being in a state of excitement against his fellow men, causes the evils spoken of, and brings them in his train as long as he fights, and long after having done fighting; the noun war, in the above sentence, is then personified, and that sentence should be expressed by—"*La guerre* entraine *après elle* des maux sans nombre."

"Everybody knows that self-love is a bad adviser; yet we take counsel from it, and permit it to direct most of our actions." We do not take counsel from a thing; and when we say that we do, we attribute to the noun which represents that thing a faculty that is only possessed by man; we then personify that noun of things; and the pronouns which relate to it should in French be expressed by the corresponding pronouns of persons; the preceding sentence should then be translated as follows: "Chacun sait que *l'amour propre* est un mauvais conseiller; cependant nous prenons conseil *de lui*, et nous *lui* permettons de diriger la plupart de nos actions."

Speaking of an army, we say, *We marched up to it.* If an army is in fact a thing, this thing is composed of men, and in the above expression the mind alludes rather to those who compose it than to the thing itself; the noun *army* is then personified, and we should say, *Nous marchâmes à elle.*

"These birds and dogs are my only pleasure; I have nothing but them. They are my only diversion; I dream of nothing else." "These horses are exhausted; give them a little wine." "These flowers will die unless they have some water." When speaking of animals, flowers, and other things we love dearly, the feelings we experience for them raise them, in our estimation, to the same level with human beings; they thus become personified, and the pronouns which relate to them should be expressed accordingly. The above sentences should therefore be rendered by—"Ces *oiseaux* et ces *chiens* sont mon seul plaisir; je n'aime qu'*eux*. *Eux* seuls m'occupent; je ne rêve qu'*à eux*." "Ces *chevaux* sont rendus; donnez *leur* un pue de vin." "Ces *fleurs* vont périr si on ne *leur* donne un peu d'eau."

"Gambling is a horrid passion; health, reputation, fortune, honour, are swallowed by it." In this sentence the noun *gambling* is not personified; *by it* cannot, therefore, be expressed literally; but the genius of the language admits of its being rendered by the adverb *there, y*, and we should say: "Le jeu est une passion horrible; la santé, la réputation, la fortune, et l'honneur s'*y* engloutissent."

"I rolled a large stone, to be able to look through the window, and mounted upon it." *Stone* is not personified, and this sentence should be rendered by suppressing the pronoun *it* altogether, which does not alter the clearness of the sentence; as, "Je fis rouler une grosse pierre, pour pouvoir regarder par la fenêtre, et je montai *dessus*."

Of the Pronouns It *and* Them, *omitted in English in answering questions, but which should be expressed in French with the Verbs of which they are the complement.*—In the following sentences:—Is this your horse? Yes, it is. Are these young men your sons? Yes, they are. Are you sick? Yes, I am. Do not forget to mention my marriage to your father, No, I will not. The answers, *Yes, it is, Yes they are, Yes I am,* and *I will not,* although complete in English, are incomplete in French; the verbs require a complement, which is, *my horse* for the first, *my sons* for the second, *sick* for the third, and *forget to mention it* for the last. But the repetition in the answer of the noun, adjective, or idea employed in the question, would cause a repetition contrary to the rules of euphony; they should not be repeated, then, but the pronouns *it* or *them* should be used in their stead, and the sentences completed as follows:—*Yes, it is* it; *Yes, they are* them; *Yes, I am* it; *No, I will not forget* it.

It remains now to be examined how these pronouns, *it* and *them*, should be expressed, according to their being used instead of a noun, an adjective, or an idea.

A noun has a number and a gender of its own; it can, therefore, impart either of them to the pronoun which takes its place; we will then establish this rule:—Whenever the pronouns *it* or *them* are expressed in French to complete the meaning of a sentence, if they take the place of a noun, they agree with that noun in number and gender, whether this sentence expresses a comparison or not, and are expressed by one of the following words, *le* (masc. sing.), *la,* (fem. sing.), *les,* (masc. and fem. plur.); as in—Will this young man ever become your son-in-law? Yes, he will. Ce jeune homme sera-t-il jamais votre gendre? Oui, il *le* sera. Will this young lady ever be your daughter-in-law? Yes, she will. Cette demoiselle sera-t-elle jamais votre belle-fille? Oui, elle *la* sera. Nobody, my dear, is more of your friend than I am. Personne, ma chère, n'est plus votre amie que je ne *la* suis. Are these young men your sons? Yes, they are. Ces jeunes gens, sont-ils vos fils? Oui, ce *les* sont.

An adjective has neither number nor gender of its own; it cannot therefore impart either to the pronoun which takes its place; hence, the following rule:—Whenever the pronoun *it* is required in French to complete the meaning of a sentence, if it takes the place of an adjective, it should be expressed by the masculine singular pronoun *le,* whatever may be the number and gender of that adjective; as in, Are you sick, sir? Yes, I am, Etes vous malade, monsieur? Oui, je *le* suis. Are you tired, madam? No, I am not, Etes vous fatiguée, madame? Non, je ne *le* suis pas. Are you pleased, ladies? Yes, we are, Etes vous contentes, mesdames? Oui, nous *le* sommes.

It sometimes happens that a noun is used as an adjective, and it is always the case when it is neither preceded by the article *the* nor the adjective *a;* then the pronouns *it* or *them* are still invariably expressed by *le;* as in, Ladies, are you relations to Mr. D.? Yes, we are, Mesdames, êtes vous *parentes* de Monsieur D.? Oui, nous *le* sommes. Gentlemen, are you men of honour? Yes, we are, Messieurs, êtes vous hommes d'honneur? Oui, nous *le* sommes. In these two sentences, the noun *relations* and the expression *men of honour* are mere qualificatives, not being preceded by the article *the* or the adjective *a.*

An idea is of no number nor gender; therefore, the pronoun *it,* employed to take the place of *one,* is always singular masculine in French and expressed by *le;* as in, Will you have the kindness to take this book to your sister? Yes, I will, Voulez-vous avoir la bonté de porter ce livre à votre sœur. Oui, je *le* ferai avec plaisir. But if the sentence should express a comparison, the pronoun *le* could be dispensed with; as in, A name has less influence on man than one might think, L'influence des noms sur les hommes est plus rare qu'on ne pense. Happy people are more numerous than you think, Les gens heureux sont plus communs que vous ne pensez.

Of the expressions To It *and* There, *omitted in English in answering questions, and which should be expressed in French with* *the Verb of which they are the complement.*—Whenever *to it* and *there* are necessary to complete the meaning of a sentence, they should be expressed in French, although they are omitted in English, and rendered by the word *y*, unless the verb before which it is to be placed should commence by the vowel *i*, in which case, euphony requires that this pronoun or adverb should also be omitted in French; as in, Will you think of me when I am gone? Yes, I will (think of it), Penserez-vous à moi quand je serai parti? Oui, j' *y* penserai. Do you think your father will be at home to-night? Yes, I think he will (be there), Croyez-vous que votre père soit chez lui ce soir? Oui, je crois qu'il *y* sera. Will you go into the country to-morrow? Yes, I think I shall (go there), Irez-vous demain à la campagne? Oui, je crois que j'irai.

Of the Pronouns Itself, Themselves (*speaking of things*).—The pronouns *itself* and *themselves* (speaking of things) are not grammatically used in English without being preceded by a preposition; but their equivalent, *se*, is employed in many cases, in French, with active and neuter verbs, to express either a situation or an action which is not the result of the interference of anybody; as in, This flower is fading fast (*fades itself*), Cette fleur *se* flétrit-vîte. If we do not drink that wine, it will get spoiled (*spoil itself*), Si nous ne buvons pas ce vin, il *se* gâtera. I let the tumblers fall and they broke to pieces (*broke themselves*), J'ai laissé tomber les verres et ils *se* sont cassés en mille pièces. But *itself* and *themselves* (speaking of things), preceded by a preposition, are very often used in English, and usage varies in French as to the manner in which they ought to be expressed; the following examples will show how our best writers have expressed these two pronouns:—Vice is odious in itself (of its nature), Le vice est odieux *en soi, lui-même*. A favour always carries its reward with itself, Un bienfait porte toujours sa récompense *avec soi*, or *lui*. Crime always carries remorse with itself, Le crime traîne toujours le remords *après soi*, or *lui*. Deception always bears its punishment in itself, Toute tromperie porte *avec elle*, or *soi*, sa punition.

It results from these examples, that the pronoun *itself* is indifferently expressed by *soi*, *lui* or *elle*; that the adjective *même* is added to these pronouns, either to avoid an ambiguity, or to convey the emphatic meaning implied in the sentence; the pronoun *itself* signifies, then, *in* or *of its nature*.

The plural pronoun *themselves* is never expressed by *soi*, but by *eux* and *elles*, followed or not by the adjective *même*, in cases similar to the preceding; as in, Vices are odious in themselves, Les vices sont odieux *en eux-mêmes*. Favours always carry their reward with themselves, Les bienfaits portent toujours leur récompense *avec eux*. Crimes always carry remorse with themselves, Les crimes traînent toujours le remords *après eux*.

Of the Pronouns One's Self, Himself, *and* Ourselves (*used Indefinitely*).—The pronoun *one's self*, as well as *himself* and *ourselves* (used indefinitely), may be used as direct or indirect objects of a verb; their antecedent is always an indefinite pronoun, a verb in the infinite mood, or a noun used in a vague and indefinite meaning; and they are expressed by the pronoun *soi*, without the adjective *même*, unless used emphatically; as in, We (indefinite) ought but seldom to speak of ourselves (indefinite), *On* ne doit parler que rarement *de soi*. It is necessary for everybody to take care of himself (indefinite), Il est nécessaire de *prendre* soin *de soi*. To love one's self and others is the duty of an honest man, *Aimer soi* et les autres est le devoir de l'homme de bien. In attempting to deceive others, we (indefinite) often deceive ourselves (indefinite), En essayant de tromper les autres, c'est souvent *soi* que l'*on* trompe. To love only ourselves (indefinite) is to be good for nothing, N'*aimer* que *soi* c'est n'être bon. To act in this manner is to ruin one's self, Agir ainsi c'est *se perdre soi-même* (emphatic). Each one works for himself (indefinite), *Chacun* travaille *pour soi*. He who ascribes everything to himself (indefinite) has but few friends, *Quiconque* rapporte tout à *soi* n'a pas beaucoup d'amis. A man (indefinite) can speak favourably of himself (indefinite) when he is calumniated, *Un homme* peut parler avantageusement *de soi* quand on le calomnie.

It sometimes happens that these pronouns are used as nominatives; but it is only by apposition, and they are then expressed by *soi-même*; as in, In trying to deceive others, we are sometimes deceived ourselves, En essayant de tromper les autres, *on* est souvent trompé *soi-même.*

Although the preceding rules are admitted by most grammarians as laws in our language, some of our best writers have inverted them, by using *soi* in relation to a definite noun of person, and *lui* in connection with an indefinite pronoun; but these are mere licences, which a foreigner should entirely disregard.

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THE ANCIENT CUSTOM OF "BARRING-OUT."*

BY P. AUSTIN NUTTALL, TRANSLATOR OF "HORACE," "JUVENAL," &C.

Quorum pars magna fui.—VIRGIL.

THE Christmas holidays were approaching, and every juvenile heart beat with pleasurable anticipations. It was a few days before the happy period arrived, when the leading scholars of the head form entertained the thought of reviving the ancient but almost obsolete custom of "barring-out" the master of the school.†

Many years had elapsed since the attempt had succeeded; and many times since that period had it been made in vain. The scholars had heard of the glorious fetes of their forefathers in their boyish years, when they set the lash of the master at defiance for days together. Now, alas! all was changed; the master, in the opinion of the boys, reigned a despot absolute and uncontrolled. The merciless cruelty of his rod, and the heaviness of his tasks, were insupportable. The accustomed holidays had been rescinded; the usual Christmas feast reduced to a nonentity, and the chartered rights of the scholars were continually violated. These grievances were discussed seriatim; and we all were *unanimously* of opinion that our wrongs should, if possible, be redressed. But how the object could be effected was a momentous and weighty affair.

The master was a clergyman of the old school, who for the last forty years had exercised an authority hitherto uncontrolled, and who had no idea of enforcing scholastic discipline without the exercise of the whip. The consequences of a failure were terrible to reflect upon; but then, the anticipation of success, and the glory attendant upon the enterprise, if successful, were sufficient to dispel every fear. At the head of the Greek class there was one whose very soul seemed formed for the most daring attempts. He communicated his intentions to a chosen few, of which the writer was one, and offered to be the leader of the undertaking, if we would promise him our support. We hesitated; but he represented the certainty of success with such feeling eloquence, that he entirely subdued our opposition. He stated that Addison had acquired immortal fame by a similar enterprise. He told us that almost every effort in the sacred cause of freedom had succeeded. He appealed to our classical recollections—Epaminondas and Leonidas were worthy of our example—Tarquin and Cæsar, as tyrants, had fallen before the united efforts of freedom; we had only to be unanimous, and the rod of this scholastic despot would be for ever broken.

We then entered enthusiastically into his views. He observed that delays were dangerous; the "barring-out," he said, "should take place the very next morning, to prevent the possibility of being betrayed." On a previous occasion (he said) some officious little urchin had told the master the whole plot—several days having been allowed to intervene between the planning of the project and its execution; and to the astonishment of the boys, it appeared they found the master at his desk two hours before his usual time, and had the mortification of being congratulated on their early attendance, with an order to be there every morning at the same hour! To prevent the recurrence of such a defeat, we determined on organizing our plans that very night. The boys were accordingly told to assemble after school hours at a well-known tombstone, in the neighbouring churchyard, as something of importance was under consideration.

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* The custom of "barring-out" long prevailed in many of the northern counties of England. Some curious particulars will be found in Brand's "Popular Antiquities," and Hutchinson's "History of Cumberland," in which county the practice appears still to prevail.

† This brief sketch was written when all the details were fresh in the recollection of the writer; and they have still left a vivid impression on the tablet of his memory, which, in all probability, will never be erased. The little juvenile *émeute* here detailed took place at the Ormskirk Grammar School, in Lancashire, which was founded by Henry Croft, Esq., in 1614. The head master is always a clergyman of the Established Church. His emoluments arise from certain endowments, which amount to about £300 per annum, and he holds at the same time the perpetual curacy of Altcar, about five miles from Ormskirk. He receives from each scholar a stated sum at Michaelmas, Christmas, and Candlemas respectively. The scholars are admitted on the recommendation of a visiting trustee, of which the vicar of the parish is one, and the scholars undergo a yearly examination, although the original intentions of the founder have of late years been much neglected. The scholars are expected to learn the Latin and Greek languages, writing and arithmetic being taught at an extra expense.

The place of meeting was an elevated parallelogram tomb-stone, which had always served as a kind of council-table to settle our little disputes, as well as parties of pleasure. Here we all assembled at the appointed time. Our leader took his stand at one end of the stone, with the head-boys, who were in the secret, on each side of him. "My boys (he laconically observed), to-morrow morning we are to *bar out* the flogging parson; and to make him promise he will not flog us hereafter without a cause; nor set us long tasks, or deprive us of our holidays. The boys of the Greek form will be your captains, and I am to be your captain-general. Those who are cowards had better retire, and be satisfied with future floggings; but you who have courage, and know what it is to have been flogged for nothing, come here and sign your names."* He immediately pulled out a pen and a sheet of paper; and having tied some bits of thread round the finger-ends of two or three boys, with a pin he drew blood to answer for ink, and to give more solemnity to the act. He signed the first, the captains next, and the rest in succession. Many of the lesser boys slunk away during the ceremony; but on counting the names we found we mustered upwards of forty—sufficient, it was imagined, even to carry the school by storm. The captain-general then addressed us:—"I have the key of the school, and shall be there at seven o'clock. The old parson will arrive at nine, and every one of you must be there before eight, to allow us one hour for barricading the doors and windows. Bring with you as much provision as you can; and tell your parents that you have to take your dinners in school. Let every one of you have some weapon of defence; you who cannot obtain a sword, pistol, or poker, must bring a stick or cudgel. Now all go home directly, and be sure to arrive early in the morning."

A more restless and anxious night, perhaps, was never passed by young recruits on the eve of a general battle. Many of us rose some hours before the time; and at seven o'clock, when the school-door was opened, there was a tolerable numerous muster. Our captain immediately ordered candles to be lighted, and a rousing fire to be made (for it was a dark December's morning). He then began to examine the store of provisions, and the arms which each had brought. In the meantime, the arrival of every boy with additional material was hailed with tremendous cheers. At length the church clock struck eight. "Proceed to barricado the doors and windows (exclaimed the captain), or the old lion will be upon us before we are prepared to meet him." In an instant the old oaken door rang on its heavy hinges. Some with hammers, gimlets and nails, were eagerly securing the windows, while others were dragging along the ponderous desks, forms, and everything portable, to blockade, with certain security, every place which might admit of ingress.

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* Our readers will find an interesting little sketch in Miss Edgeworth's collection of Juvenile Stories, called the "Barring-out, or Party Spirit," which is not very dissimilar from the Ormskirk school proceedings. "The arrangement of the affair," she observes, "was left to the new manager, to whom all pledged implicit obedience. Obedience, it seems, is necessary, even from rebels, to their ringleaders—not reasonable, but implicit obedience. Archer [the name of the captain, or manager, as she calls him] and his associates, agreed to stay the last in the school-room, and as soon as the Greybeards [a name given to an opposing party of boys] were gone out to bed, he, as a signal, was to shut and lock one door, and Townsend the other; a third conspirator was to strike a light, in case they should not be able to secure a candle; a fourth was to take charge of the candle as soon as lighted; and all the rest were to run to the bars, which were secreted in the room, then to fix them to the common fastening-bars of the window, in the manner in which they had been previously instructed by the manager. Thus each had his part assigned, and each was warned that the success of the whole depended upon their order and punctuality. Order and punctuality, it appears, are necessary even in a barring-out, and even rebellion must have its laws."

This operation being completed, the captain mounted the master's rostrum, and called over the list of names, when he found only two or three missing. He then proceeded to classify them into divisions or companies of six, and assigned to each its respective captain. He prescribed the duties of each company. Two were to guard the large casement window, where, it was expected, the first attack would be made; this was considered the post of honour, and consequently the strongest boys, with the most formidable weapons, were selected, whom we called Grenadiers. Another company, whom we considered as the Light Infantry, or Sharp Shooters, were ordered to mount a large desk in the centre of the school; and, armed with squibs, crackers, and various missiles, they were to attack the enemy over the heads of the combatants. The other divisions were to guard the back windows and door, and to act according to the emergency of the moment.

Our leader then moved some resolutions (which in imitation of Brutus he had cogitated during the previous night), to the effect that each individual should implicitly obey his own captain, that each captain should follow the orders of the captain-general, and that a corps-de-reserve should be stationed in the rear to enforce this obedience, and prevent the combatants from taking to flight. The resolutions were passed amidst loud vociferations.

An examination of the various weapons then commenced, which we found to consist of one old blunderbuss, one pistol, two old swords, a few rusty pokers, and sticks, stones, squibs, and gunpowder in abundance. The fire-arms were immediately loaded with blank powder; the swords were sharpened, and the pokers heated in the fire. These weapons were assigned to the most daring company, who had to protect the principal window. The missiles were for the light infantry, and all the rest were armed with sticks.

We now began to manœuvre our companies, by marching them into line and column, so that every one might know his own situation. In the midst of this preparation the sentinel, whom we had placed at the window, loudly vociferated, "The parson! the parson's coming!" In an instant all was confusion. Every one ran he knew not where, as if eager to fly, or screen himself from observation. Our captain instantly mounted a form, and called to the captains of the two leading companies to take their stations. They immediately obeyed; and the other companies followed their example; though they found it much more difficult to manœuvre when danger approached, than they had a few minutes before!

The well-known footstep, which had often struck on our ears with terror, was now heard to advance along the portico. The master tried to lift the latch again and again in vain. The muttering of his stern voice sounded on our ears like the lion's growl. A deathlike silence prevailed. We scarcely dared to breathe. The palpitations of our little hearts could perhaps alone be heard. The object of our dread then went round to the front window, for the purpose of ascertaining whether any one was in the school. Every footstep struck us with awe; not a word, not a whisper was heard. He approached close to the window; and with an astonished countenance stood gazing upon us, while we were ranged in battle array, motionless as statues, and silent as the tomb.

"What is the meaning of this?" he impatiently exclaimed. But no answer could he obtain; for who would then have dared to render himself conspicuous by a reply? Pallid countenances and livid lips betrayed our fears. The courage which one hour before was ready to brave every danger, appeared to be fled. Every one seemed anxious to conceal himself from view; and there would certainly have been a general flight through the back windows, had it not been for the prudent regulation of a corps-de-reserve, armed with cudgels to prevent it.

"You young scoundrels, open the door instantly," he again exclaimed, and what added to our indescribable horror, in a fit of rage he dashed his hand through the window, which consisted of small diamond-shaped panes, and appeared as if determined to force his way in. Fear and trepidation, attended by an increasing commotion, now possessed us all.

At this critical moment every eye turned to our captain, as if to reproach him for having brought us into this terrible dilemma. He alone stood unmoved; but he saw that none would have courage to obey his commands. Some exciting stimulus was necessary. Suddenly waving his hand, he exclaimed aloud, "Three cheers for the barring-out, and success to our cause!" [Hurra! hurra! hurra!] The cheers were tremendous. Our courage revived; the blood flushed in our cheeks; the parson was breaking in; the moment was critical. Our captain, undaunted, sprang to the fireplace, seized a heated poker in one hand, and a blazing torch in the other. The latter he gave to the captain of the Sharpshooters, and told him to prepare a volley; when with the red-hot poker he fearlessly advanced to the window-seat; and daring his master to enter, he ordered an attack—and an attack indeed, was made, sufficiently tremendous to have repelled a more powerful assailant. The missiles flew at the ill-fated window from every quarter. The blunderbuss and the pistol were fired; squibs and crackers, ink-stands and rulers, stones, and even burning coals, came in showers about the casement, and broke some of the panes into a thousand pieces; while blazing torches, heated pokers, and sticks, stood bristling under the window.

The whole was scarcely the work of a minute. The astonished master reeled back in dumb amazement. He had evidently been struck with a missile, or with the broken glass; and probably fancied he was wounded by the fire-arms.

The school now rang with the shouts of "victory," and continued cheering.

"The enemy again approaches," cries the captain; "fire another volley;—stay; he seeks a parley—hear him."

"What is the meaning, I say, of this horrid tumult?"

"The barring-out! the barring-out!" a dozen voices instantly exclaimed.

"For shame," says he, in a tone evidently subdued; "what disgrace you are bringing upon yourselves and the school. What will the trustees—what will your parents say? William," continued he, addressing the captain, "open the door without further delay."

"I will, sir," he replied, "on your promising to pardon us, and to give us our lawful holidays, of which we have lately been deprived; and not set us tasks during the holidays."

"Yes, yes," said several squealing voices, "that is what we want; and not to be flogged for nothing."

"You insolent scoundrels! you consummate young villains!" he exclaimed, choking with rage, and at the same time making a furious effort to break through the already shattered window. "Open the door instantly, or I'll break every bone in your hides."

"Not on those conditions," replied our captain, with provoking coolness. "Come on, my boys; another volley."

No sooner said than done, and even with more fury than before. Like men driven to despair, who expect no quarter on surrendering, the little urchins daringly mounted the window-seat, which was a broad, old-fashioned one, and pointed the fire-arms and heated poker at him; whilst others advanced with the squibs and missiles.

"Come on, my lads," says the captain, "let this be our Thermopylæ, and I will be your Leonidas." And indeed so daring were they, that each seemed ready to emulate the Spartans of old.

The master, perceiving their determined obstinacy, turned round without further remonstrance, and indignantly walked away.

Relieved from our terrors, we now became intoxicated with joy. The walls rang with repeated hurrahs! In the madness of enthusiasm some of the boys began to tear up the forms, throw the books about, break the slates, locks, and cupboards, and act so outrageously that the captain called them to order; not, however, before the master's desk and drawers had been broken open, and every plaything, which had been taken from the scholars, restored to its owner.

We now began to think of provisions. They were all placed on one table, and dealt out in rations by the captains of each company. In the meantime we held a council of war, as we called it, to determine on what was to be done.

In a recess at the east end of the school, there stood a large oak chest, black with age, whose heavy hinges had become corroded with years of rust. It was known to contain the records and endowments of the school, and, as we presumed, the regulations for the treatment of the scholars. None of us had ever seen its inside. Attempts, dictated by insatiable curiosity, had often been made to open it; but it was deemed impregnable. It was guarded by three immense locks, and each key was in the possession of different persons. The wood appeared to be nearly half a foot thick, and every corner was plaited with iron.

All eyes were instinctively directed to this mysterious chest. Could any means be devised for effecting an entrance? was the natural question. We all proceeded to reconnoitre. We attempted to move it, but in vain. We made some feeble efforts to force the lid; it was firm as a block of marble.

At length one daring urchin brought from the fire-place a red-hot poker, and began to bore through its sides. A universal shout was given. Other pokers were brought, and to work they went. The smoke and tremendous smell which the old wood sent forth rather alarmed us. We were apprehensive that we might burn the records, instead of obtaining a copy of them. This arrested our progress for a few minutes.

At this critical moment a shout was set up that the parson and a constable were coming! Down went the pokers, and, as if conscience-stricken, we were all seized with consternation. The casement window was so shattered, that it could easily be entered by any resolute fellow. In the desperation of the moment we seized the desks, forms, and stools, to block it up; but our courage in some degree had evaporated; and we felt reluctant to act on the offensive. The old gentleman and his attendant deliberately inspected the windows and fastenings; but, without making any attempt to enter, they retreated, for the purpose, as we presumed, of obtaining additional assistance.

What was now to be done? The master appeared obdurate; and we had gone too far to recede. Some proposed to drill a hole in the window-seat, fill it with gunpowder, and explode it, if any one attempted to enter. Others thought we had better prepare to set fire to the school sooner than surrender unconditionally. But the majority advised, what was perhaps the most prudent resolution, to wait for another attack; and, if we saw no hopes of sustaining a longer defence, to make the best retreat we could.

The affair of the barring-out had now become known, and persons began to assemble round the windows, calling out that the master was coming with assistants, and saying everything to intimidate us. Many of us were completely jaded with the over-excitement we had experienced since the previous evening. The school was hot, close, and full of smoke. Some were longing for liberty and fresh air; and most of us were of opinion that we had engaged in an affair which it was impossible to accomplish.

In this state of mind we received another visit from our dreaded master. With his stick he commenced a more furious attack than before; and observing us less turbulent, he appeared determined to force his way, in spite of the barricadoes. The younger boys thought of nothing but flight and self-preservation; and the rush to the back-windows became general.

In the midst of this consternation our captain exclaims, "Let us not fly like cowards; if we must surrender, let the gates of the citadel be thrown open; the day is against us; but let us bravely face the enemy, and march out with the honours of war." Some few had already escaped; but the rest immediately ranged themselves on each side of the school, in two extended lines, with their weapons in hand.

The door was thrown open—the master instantly entered, and passed between the two lines, denouncing vengeance on us all. But as he marched in, we marched out in military order; and giving three cheers we dispersed into the neighbouring fields.

We shortly met again, and after a little consultation it was determined that none of the leaders should come to school until sent for, and a free pardon given.

The defection, however, was so general, that no corporeal punishments took place. Many of the boys did not return till after the holidays; and several of the elder ones never entered the school again.

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PRACTICAL ESSAYS ON EDUCATION.

DUTIES OF THE TEACHER.—(*Continued.*)

Another powerful means of gaining the affections of your scholars is by the judicious use of praise. An encouraging smile, or a word of commendation, will sometimes work wonders. That Captain Basil Hall, a man of great experience, was of the same opinion as myself in this respect, the following words will prove:—"It requires," says he, "but very little knowledge of soldiers or sailors, children, servants, or any other kind of dependants, to show that good-humour on our part towards those whom we wish to influence, is the best possible coadjutor to our schemes of management, whatever these may be."

There is another consideration which should have its effect upon us in regard to the use of praise. I may mention it in the words of the Duc de la Rochefoucauld:—"The desire of meriting the praise we receive fortifies our virtue; and that bestowed on talent, courage, and beauty contributes to augment them."

One piece of advice I must on no account omit—namely, be uniform in your plans of government. Be to-day what you were yesterday, and what you intend to be to-morrow. This is not an easy matter, subject as all men are to variations in health and spirits, materially affecting the view they take of conduct. "We are sometimes," as one of the great searchers into the human heart has said, "as different from ourselves as we are from others." But the manifest importance of an attempt at perfect uniformity will suggest the necessity of taking every possible precaution, not only against—

> "Those cataracts and breaks
> Which humour interposed too often makes,"

but also against those irregularities in the treatment of offences against discipline which arise either from forgetfulness or caprice. "Inconsistency of discipline," says Dr. Knox, "is very hurtful. One day some teachers will be all indulgence, and the next all severity. The child knows not what conduct to follow in order to give constant satisfaction. He is beaten or reprimanded to-day for what gained him yesterday some mark of commendation or applause."

To guard against this evil, have but few rules, and see that these are well understood, and cultivate diligently the habit of rigid self-government. Mr. Dunn is quite justified in saying that "he can never rule another successfully who has not first learned to govern himself." But self-government is a virtue, it must be confessed, of no easy attainment, implying, as it commonly does, much painful discipline, and sometimes a degree of mental endurance which the strongest motives alone can enable a man to bear. It must extend not only to the government of the temper and passions, but to the regulation of the whole conduct.

The manner in which any particular branch of instruction is communicated to your pupils deserves your serious consideration. It should be delivered in such a manner and form that is most likely to arrest their attention, and to make the most lasting impression upon their minds.

"A readiness to draw forth," observes Mr. Wood, "from the learners themselves familiar illustrations of every subject adapted to their age, and to the other circumstances in which they are placed, is an important duty on the part of the teacher." The opportunity afforded for consulting all such circumstances in the pupils' condition is certainly one of the superior advantages of domestic education, though counterbalanced (where the education is exclusively domestic) by many disadvantages. But even a public teacher has some room for exercise of this important tact. Scope is often afforded for its exercise in consulting the capacities and inclinations, not merely of a whole class, but even of individual scholars. The curiosity of a child ought by no means unnecessarily "to be baulked;" and the teacher who is persuaded of the truth of Locke's observation, that "a child will learn three times as much when he is in tune" as at any other time, is much more likely to put his pupils in tune, and to find them in it, than he who consults only his own inclination, or moves continually in the same unvaried routine. A single rash rebuff, or cold reply, given to a child at a time when his curiosity is most ardent, may mar for life a promising scholar.

"Many teachers," says an anonymous writer in the *Educational Times*, "fancy that from their much talking they must be understood by their pupils; but when they refine too far, they overleap themselves, and fall down on the other side. A teacher should never attempt to teach anything beyond the reach of his pupils' understandings; for all beyond that is a mischief." He should not, indeed, attempt too much, but pour in knowledge gently. Plato observed that the minds of children were like bottles with very narrow mouths; if you attempted to fill them too rapidly, much knowledge was wasted, and little received; whereas, with a small stream, they were easily filled. Those who would make young children prodigies act as wisely as if they would pour a pail of water into a pint measure.

I am the more anxious to direct your particular attention to this point, as I think there are few good schools where there is not some danger of one or more minds being injured by an excessive intellectual development. The vanity of the parent, the ambition of the child, the intense pleasure which the teacher experiences when he succeeds in exciting and developing one or more faculties to an extraordinary extent, all combine to promote that excessive intellectual activity which is always perilous, and sometimes even fatal. I am sure I need not enlarge upon the moral effects of this unnatural excitement, how it enfeebles the will and excites the passions; nor is it, perhaps, more necessary to speak of the physical effects, for all medical writers who have treated on the subject assert that undue, and especially premature, intellectual development is the frequent forerunner of impaired health and of an early grave.

Take care, then, of precocious children; have no part in the fearful process which is handing them over to disease and death.

Rather desire to have a child, while he is a child, think as a child; and put away childish things then only when they cease to be in character. Do not wish "a child to have a maturity of understanding unnaturally early." Recollect the wise saying of the ancient—"Soon enough, if well enough."

Among all your earnest endeavours for the improvement of your pupils—religiously, morally, and intellectually—it must be remembered that the co-operation of the parents must be sought, and, if possible, secured. They may be ignorant, prejudiced, or capricious, or they may have all these united; nevertheless you must strive to get them on your side. You must call upon or send for them, and advise with them in cases where strong measures are unfortunately necessary; and you must show respect to that strong and instinctive, though frequently blind, attachment to their young, which may occasion them for a time to resent as an injury that which you inflicted only as a necessary duty.

And here I may be allowed to give a hint in reference to the choice of a school by the parents for their children.

Although it is perfectly true that a man cannot give to others what he has not himself, yet it does not consequently follow that because he himself possesses knowledge in great perfection, he must be proportionally endowed with the faculty of communicating the rudiments of that knowledge to others. I am firmly persuaded that what has been called "aptness to teach," is a talent of a peculiar kind, which even long practice does not always confer. To practice this art successfully, the teacher must secure the affections of his dullest pupil, must condescend to place himself in his situation, must feel his difficulties, and thus know the method by which they are most likely to be surmounted.

Now, it is not every man of genius and of high acquirements that can stoop so low. Perfect master of his own subject, he cannot make an allowance for an utter unacquaintance with it on the part of others; what he himself perhaps acquired with facility, he cannot, under any circumstances, imagine to be a matter of difficulty. All, accordingly, who do not readily follow him, or do not accomplish tasks which are above their strength, he sets down as unconquerably lazy, or unconquerably dull, that he needs not give himself any further trouble about them; forgetting that the fault may be in himself, and that the highest excellence of a teacher consists, not in making a few excellent scholars, but in rendering all in the same class equally good scholars.

It must be understood that I do not affirm that the learned scholar and the able teacher may not be combined in one and the same individual; nor do I deny that such a combination has a most decided advantage on its side. I am well aware that the man of learning and information has constant stores at hand, which, properly used, may be of the greatest service in illustrating even the rudiments of knowledge, as well as in forming a taste for its higher acquirements. But, at the same time, whenever it comes to be a question, whether superior scholarship, without aptitude for teaching, or aptitude for teaching, with a moderate share of scholarship, should be preferred, there seems to be little room for hesitation in deciding in favour of the latter.

Dr. Arnold's opinions on this subject are corroborative of what I have here advanced. In a letter of inquiry for a master, he says—"What I want is a man who is a Christian and a gentleman—an active man, and one who has common sense, and understands boys. I do not so much care about scholarship, as he will have immediately under him the lowest forms in the school; but yet, on second thoughts, I do not care about it very much, because his pupils may be in the highest forms; and besides, I think that even the elements are best taught by a man who has a thorough knowledge of the matter. However, if one must give way, I prefer activity of mind and an interest in his work to high scholarship: for the one may be acquired far more easily than the other."

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SAYINGS OF WISE MEN.—No. II.

A True Conqueror.—"He who," says Lavater, "being master of the fittest moment to crush his enemy, magnanimously neglects it, is born to be a conqueror." In the year 1746, when England was at war with Spain, the *Elizabeth*, a merchant ship belonging to London, laden with a valuable cargo, sprung a leak while on her voyage between Jamaica and Cuba. The sailors, to save their lives, ran the vessel into the Havannah, a Spanish port, where they fully expected to be made prisoners of war, and to have their ship seized as a prize. The captain went on shore to deliver her up to the Spanish governor, and to entreat that he and his men might not be cruelly treated. To his extreme surprise, the governor refused to seize either men or vessel. "Had you come," said he, "with hostile intentions, you would have been a legitimate prize; but since you come only as distressed mariners, humanity impels me, instead of injuring, to assist you to the utmost of my power. You are at liberty to repair your vessel in this port, and to trade so far as shall be necessary to pay your expenses, and then to depart as freely as one of our own vessels." The Englishman, overwhelmed with gratitude at this magnanimous conduct, acted up to the advice of the Spaniard, and refitted his ship. When ready for sea, the governor gave him a pass, which was to have the effect of protecting him from the war vessels of Spain till he was beyond Bermuda. The *Elizabeth* then sailed in peace, and in a few weeks arrived safely in the Thames.

Death and Eternity.—"The deaths of some, and the marriages of others," says Cowper, "make a new world of it every thirty years. Within that space of time the majority are displaced, and a new generation has succeeded. Here and there one is permitted to stay longer, that there may not be wanting a few grave Dons like myself to make the observation."

Man is a self-survivor every year;
Man, like a stream, is in perpetual flow.
Death's a destroyer of quotidian prey;
My youth, my noontide his, my yesterday;
The bold invader shares the present hour,
Each moment on the former shuts the grave.
While man is growing, life is in decrease,
And cradles rock us nearer to the tomb.
Our birth is nothing but our death begun,
As tapers waste that instant they take fire.
Young.

"The created world," says Sir Thomas Browne, "is but a small parenthesis in eternity, and a short interposition for a time between such a state of duration as was before it, and may be after it."

Cunning Men.—"The most subtle of all artifices," says Rochefoucauld, "is the power of cleverly feigning to fall into the snares laid for us; and we are never so easily deceived as when we think we are deceiving others." This maxim has been slightly varied by Bulwer. He says—"The surest way of making a dupe is to let your victim suppose that you are his." A curious illustration was lately exhibited in the events which led to the defeat of the King of Sardinia, in Lombardy, in July, 1848. He was beguiled by a pretended plot for delivering the town of Mantua into his hands; and, with a view of aiding in its execution, was induced to weaken his military position to such a degree as to enable the Austrian general, Radetzky, to attack him at a disadvantage. The Italian correspondent of the *Times* newspaper (August 2, 1848), remarks upon this—"I perceive that the whole affair was, to use a vulgar but expressive phrase, 'a plant' to induce the king to impoverish the left of our lines, where Radetzky saw, as events have since proved, that he might strike the surest blow. I have often noticed that cunning men are the most easily deceived, and I fear Charles Albert, who has the reputation of being very *rusé*, has thus been caught."

VICE AND VIRTUE.—"The mind of man," says Hazlitt, "is like a clock that is always running down, and requires to be as constantly wound up. The *ideal* principle is the master-key that winds it up, and without which it would come to a stand: the sensual and selfish feelings are the dead weights that pull it down to the gross and grovelling. Till the intellectual faculty is destroyed—so that the mind sees nothing beyond itself on the present moment—it is impossible to have all brutal depravity; till the material and physical are done away with—so that it shall contemplate everything from a purely spiritual and disinterested point of view—it is impossible to have all virtue. There must be a mixture of the two, as long as man is compounded of opposite materials, a contradiction and an eternal competition for the mastery. I by no means think a single bad action condemns a man, for he probably condemns it as much as you do; nor a single bad habit, for he is probably trying all his life to get rid of it. A man is only thoroughly profligate when he has lost the excuse of right and wrong; or a thorough hypocrite, when he has not even the wish to be what he appears. Any one may yield to temptation, and yet feel a sincere love and aspiration after virtue; but he who maintains vice in theory has not even the conception or capacity for virtue in his mind. Men err: fiends only make a mock at goodness."—*Essay on Cant and Hypocrisy.*

PUNISHMENT.—A less punishment which is certain will do more good than a greater which is uncertain.—*Beccaria.*

Punishment is effectual in proportion to its certainty, not to its severity.—*H. Dunn.*

We will give one confirmation, out of many which might be adduced, of the truth of the above remark. During the wars in Flanders, in the reign of Queen Anne, when the Duke of Marlborough and Prince Eugene commanded the allied army, a soldier in the division of the latter was condemned to be hanged for marauding. The man happened to be a favourite with his officers, who took great pains to save his life, and for this purpose interceded with the Prince, who positively refused to grant their request. They then applied to the Duke of Marlborough, begging his Grace to interfere; he accordingly went to Prince Eugene. "I never did, and never will, consent to the pardon of a marauder," was the reply. "Why," said the Duke, "at this rate we shall hang half the army. I pardon a great many." "That," answered the Prince, "is the reason that so much mischief is done by your people, and that so many suffer for it. I never pardon any, and therefore there are very few to be punished in any department." The Duke still urged his request. "Let the matter be inquired into," then said the Prince, "and if your Grace has not executed more than I have done, I will consent to the pardon of this fellow." The proper inquiries were accordingly made, and the numbers turned out very highly in favour of Prince Eugene. "There, my Lord," exclaimed he, "you see the benefit of example. You pardon *many*; I never pardon *one*; therefore *few* dare to offend, and, of course, but *few* suffer."

TRUTH.—Truth, considered in itself, and in the effects natural to it, may be conceived of as a gentle spring or water-source, warm from the genial earth, and breathing up into the snow-drift that is piled over and around its outlet. It turns the obstacle into its own form and character, and as it makes its way increases its stream; and should it be arrested in its course by a chilling season, it suffers delay, not loss, and waits only for a change in the wind to awaken, and again roll onwards.—*S. T. Coleridge.*

NEVER DESPAIR.—"Ah!" replied Sancho, weeping, "don't die, your honour, but follow my advice, and live many years; because the silliest thing a man can do in this life is to die without any reason—without being killed by anybody, or finished off by any other hands than Melancholy's.—*Cervantes.*

THE MONTHS—SEPTEMBER.

[THE USUAL ENGRAVING WILL APPEAR IN THE NEXT NUMBER.]

"Next him September marched eke on foot;
Yet was he heavy-laden with the spoyle
Of harvest's riches, which he made his boot,
And him enriched with bounty of the soyle.
In his one hand, as fit for harvest's toyle,
He held a knife-hook; and in th' other hand
A paire of weights, with which he did assoyle
Both more and lesse, where it in doubt did stand,
And equal gave to each as justice duly scanned."

The beauties of Summer are gone, the golden-eared corn has been stored, and the fading verdure gives notice that the year is declining.

"Yet we mark it not; fruits redden,
Fresh flowers blow as flowers have blown,
And the heart is loth to deaden
Hopes that she so long hath known."

Mr. Leigh Hunt remarks that "this is the month of the migration of birds, of the finished harvest, of nut-gathering, of cyder and perry-making, and towards the conclusion, of the change of colour in trees."

The varied and changing tints of a September landscape have their own peculiar charms for the lover of Nature who delights in the many hues around him. 'Tis true, Flora's painted carpet has given place to the more simple one of green, and that the orchards teem with ruddy apples, and juicy pears, inviting to the casual passer-by, who gazes with wistful eye upon the bending branches.

"The concert ceases in the shady grove;
No more the warblers in full chorus join;
From tree to tree with fainter notes they rove."

September is literally the seventh, but virtually the ninth month of the year. Its name is derived from *Septem*, seven, and *Imber*, a shower of rain, as this is generally the commencement of the rainy season. It had only sixteen days assigned to it in the Alban calendar; but they were increased to thirty by Romulus, and to thirty-one by Julius Cæsar, while Augustus reduced the number of days to the present number—thirty.

Our Saxon ancestors called this month *Gerst monath*. Verstegan informs us that the reason it was thus called, was, "that barley which that moneth commonly yeelded, was antiently called *gerst*, the name of barley being given unto it by reason of the drinke therewith made, called beere, and from *beerlegh* it came to be *berlegh*, and from *berleg* to *barley*. So, in like manner, *beereheym*, to wit, the overdecking or covering of *beere*, came to be *berham*, and afterwards *barme*, having since gotten, I wot not, how many names besides. This excellent and healthsome liquor, beere, antiently also called *ael*, as of the Danes it yet is (beere and ale being in effect all one), was first of the Germans invented, and brought into use."

The synonymes of the month are as follows: in Latin, *September*; French, *Septembre*; Italian, *Settembre*; and Portuguese, *Setembro*.

This month was allegorically represented as a young man dressed in purple, with a wreath of white and purple grapes upon his head, and his countenance merry. Under his left arm he held a bundle of oats, and in his right hand a cornucopia of the ripe fruits of the season, and the sign of *Libra*, the balance, on his right, symbolical of the sun entering that constellation on the 23rd of the month.

The chronology of the month next demands some consideration.

CALENDAR FOR THE MONTH.

1. Partridge shooting begins.—*St. Giles.*
2. The Fire of London commenced 1666.
3. Cromwell died 1658.—John Goodwin died 1665.
4. Cassini died 1784.
5. Robert Fergusson born 1751.
6. Marshal Blucher died 1819.
7. *Eunurchus.*—Hannah More d. 1833.—Buffon born 1707.
8. *Nativity of the Virgin Mary.*—Bishop Hall died 1656.
9. Battle of Flodden 1513.
10. Ugo Foscolo, a celebrated Italian writer, died 1827.
11. Mohammed born 569.
12. Sir W. Dugdale born 1605.
13. General Wolfe killed 1759.
14. *Holy Cross.*—Moscow burnt 1812.—Dante died 1321.
15. Hon. W. Huskisson died 1830.
16. Buck hunting ends.—Omnibuses introduced 1830.
17. *St. Lambert.*—London and Birmingham Railway opened 1838.
18. Matthew Prior died 1721.—Lawrence Sterne died 1768.
19. Battle of Poictiers 1356.
20. W. Wykeham died 1404.

21. *St. Matthew.*—Sir Walter Scott died 1832.
22. Charles V. died 1558.
23. Autumn Quarter begins.—Dr. S. Butler died 1680.
24. Jerome Cardan born 1501.
25. R. Porson died 1808.
26. *St. Cyprian.*—Admiral Lord Collingwood born 1748.
27. William Rufus crowned 1087.
28. The Royal Exchange, London, opened 1669.—George Buchanan, the Scotch poet and historian, died 1582.
29. *Michaelmas Day.*—Lord Nelson born 1758.—Battle of Nicopolis 1393.
30. *St. Jerome.*—George Whitfield died 1770.

THE RED LETTER DAYS of the month are tolerably numerous, being as follows:—

1*st.*—"*St. Giles's Day.*"—St. Giles was born at Athens, and became Abbot of Nismes, in France, in 715, and died in 750. He is the patron saint of beggars and cripples. St. Giles's Church, Cripplegate, London, and the High Church, in Edinburgh, are dedicated to him. Various marvellous tales are related of this saint, one of which is, that he cast two doors of cypress wood into the river Tiber, and recommended them to heavenly guidance; and on his return to France, finding them at the gates of his monastery, he set them up as the doors of his own church. It is said that the reason he became the patron of beggars and cripples, is because in his youth he literally fulfilled the scriptural injunction by selling his patrimony for the benefit of the poor; and that while going to church, being solicited by a sick beggar for alms, he took off his coat and gave it to him, and that instantly the beggar was cured.

7*th.*—"*St. Eunurchus,*" *Enurchus,* or *Evurtius.*—This saint is retained in the Church of England calendar; but all that we can learn respecting him is, that he was a bishop of Orleans, who lived in the reign of Constantine, and died about 340.

8*th.*—"*The Nativity of the Virgin Mary.*"—This is a grand festival in the Romish Church, and is still retained in the Church of England calendar. It has been held in honour of the Virgin Mary for more than a thousand years, with matins, masses, homilies, collects, processions, and other ceremonies. According to some writers, this festival originated from a religious contemplative always having certain revelations every year upon the 8th of September, when he heard most sweet sounds of music in heaven, with great rejoicings of the angels. Upon one occasion he inquired the cause of one of them, and was informed that upon that day was celebrated in heaven the nativity of the mother of God. In consequence of this supposed revelation, Pope Servius immediately appointed an annual festival in honour of the Virgin.

14*th.*—"*The Exaltation of the Holy Cross,*" or, as it is sometimes called, "*Holyrood Day.*"—This is a festival of the Romish Church, retained in the Church of England calendar. It celebrates the miraculous appearance of a cross in the heavens, to the Emperor Constantine. It was instituted by the Romish Church, on the occasion of the Emperor Heraclius defeating Cosroes, king of Persia, who took away a large piece of the pretended real cross from Jerusalem, which Heraclius re-took, and bore back in triumph.

Holyrood House, Edinburgh, derives its name from this day. The *rood* was a carved group of the four evangelists, or our Saviour, with the Virgin Mary on one side, and St. John on the other. This group was placed in a gallery across the nave, near the chancel or choir of the church, which was henceforth called the *rood-loft,* or rood-gallery; here the choir, or musicians who performed the mass, were placed during the service. Some of the roods were so constructed, that the eyes, lips, and heads of the figures moved when the votaries approached them; but when these roods were removed from the walls of the various churches, and scriptural texts painted there in their place, the impostures of the priests were exposed. Hilsey, Bishop of Rochester, took the famous *Boxley Rood,* or "Rood of Grace," to pieces, and publicly showed the people the springs and wheels, by which, at the wish of the priests, it had been secretly put in motion. The rood in St. Paul's Cathedral, London, was the first taken down, and afterwards the others were gradually removed from the metropolitan churches.

Antiquaries inform us that nutting commenced upon this day, and that a custom prevailed in Eton school for the scholars to go out and gather nuts, and enjoy themselves; and that when they returned, a portion of the nuts were presented to the several masters. In those days, when a parent made a journey from the country to Eton, if he chanced to visit the spot upon this day, he was quietly informed that

"All the youth are now a nutting gone."

17*th.*—"*St. Lambert.*" This saint is a Romish saint, who is oft called St. Landebert. He was Bishop of Maestricht, and having been expelled therefrom in 673, he retired to the monastery of Staveld, where he rigidly conformed to its rules for seven years, after which he was restored to his bishopric. He was murdered upon the 17th September, 703, during the dissensions that prevailed in France, and in 1203 this day was ordered to be kept in remembrance of him.

21*st.*—"*St. Matthew.*"—This day is a festival of the Church of England, held in honour of the son of Alpheus, who is said to have died a martyr in Ethiopia.

Upon this day, the Lord Mayor, aldermen, sheriffs, and governors of the various Royal hospitals and charities in London, attend divine service, and afterwards visit Christ's Hospital, when orations are delivered in Latin and English by the two senior scholars in the school, who are qualifying for college. A sumptuous dinner finishes the day's observances.

29*th.*—"*Michaelmas Day*" is a festival instituted in the year 487, in honour of St. Michael and All the Holy Angels. It is a great festival of the Romish Church, and is still retained in the calendar of the Church of England. Wheatley, in his exposition of the "Book of Common Prayer," remarks, "that the feast of St. Michael and All Angels is observed, that the people may know what benefits we derived from the ministry of angels."

Many very curious customs are observed in different parts of this kingdom upon Michaelmas Day, but our space only permits us to notice a few. For example, in Kidderminster, the inhabitants assemble at a particular hour of the day, which is announced by the ringing of the town-house bell, and during one hour—termed lawless hour—the poorer class of people amuse themselves by throwing cabbage stalks at each other, while the higher classes throw apples. In some parts of Scotland the people bake a cake upon this day, which is called "St. Michael's bannock." In Ireland a sheep is often killed upon this day, and a part of it given to the poor. In England, "Geese are ordain'd to bleed at Michael's shrine." The English custom of having a roast goose upon Michaelmas Day seems to have arisen from the goose being in better condition at this period, when it had had the range of the reaped harvest fields. Antiquaries, as usual, are not agreed upon the origin of this custom.

Brady says that this festival "is no longer peculiar for that hospitality which we are taught to believe formerly existed, when the landlords used to entertain their tenants in their great halls upon *geese*: then only kept by persons of opulence, and of course considered as a peculiar treat, as was before the case at Martinmas, which was the old regular quarterly-day; though, as geese are esteemed to be in their greatest perfection in the autumnal season, there are but few families who totally neglect the ancient fashion of making that bird a part of their repast on the festival of St. Michael."

It has often been related that this custom originated with Queen Elizabeth, who, being on her way to Tilbury Fort, on the 29th September, 1588, repaired to the seat of Sir Neville Humfreville, near to that place, and that he, knowing her taste for high-seasoned dishes, provided a goose for dinner. She is said to have relished it amazingly, and to have drank a half-pint bumper of Burgundy immediately afterwards to the destruction of the Spanish Armada. The tradition informs us, that she had scarcely drained the cup, when the intelligence was brought that her wishes had been fulfilled; and that, in commemoration of that event, and out of compliment to her host, she ordered a goose for her dinner upon the 29th of September every year; therefore the Court and people followed her example, and the custom was henceforth established. All this is contradicted by several antiquaries, among whom we may mention Brand, who adduces evidence to prove that the custom was practised long anterior to the destruction of the Spanish Armada; and he therefore only regards the anecdote related above as a proof that the custom pevailed at Court in the days of Queen Bess. Mr. Brand considers that the custom was in use in the tenth year of King Edward the Fourth; inasmuch as, among other services, John de la Huy was bound to render to William Barnaby, Lord of Lastres, in the county of Hereford, for a parcel of the demesne lands, twenty pence a-year and one *goose* fit for the lord's dinner on the feast of St. Michael, the Archangel. In the "Posies of Gascoigne," published in 1575, are the following lines:—

"And when the tenanntes come to paie their quarter's rent,
They bring some fowle at Midsummer, a dish of fish in Lent,
At Christmasse a capon, at *Michaelmasse a goose*;
And somewhat else at New-yeres tide, for feare their lease flie loose."

It would therefore seem as if the custom originated among the tenantry, in then carrying a fat stubble goose with their rent to the landlord at Michaelmas, who might possibly have distributed them among their friends. It is a common saying, that "If you cut goose on Michaelmas day, you will never want money all the year round." In Poor Robin's Almanack for 1695, under September, are these quaint lines:—

"Geese now *in their prime season are*,
Which, if well roasted, are good fare:
Yet, however, friends, take head,
How too much you on them feed,
Lest, when as your tongues run loose,
Your discourse *do smell of goose*."

This day is a holiday at the public offices; and one of the Aldermen of London performs an ancient ceremony, as tint and service of certain old tenures, of counting hob-nails and chopping sticks.

30th.—"*St. Jerome*." This saint was born at Pannonia about the year A.D. 340, and died A.D. 420. He went to Rome, where he studied under Donatus, the grammarian. He then visited Gaul, having been previously baptised; and afterwards travelled in Thrace, Pontus, Bithynia, Galatia, and Cappadocia; after some time he returned to Rome, and acted as secretary to Pope Damasus, but ultimately took up his abode in a monastery at Bethlehem, where he employed himself in retirement by writing on theological subjects. His greatest work is the translation of the books of the Old and New Testament into Latin, which is commonly known as the Vulgate.

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LESSONS IN NATIONAL HISTORY.

No. III.

"The age of mystery with its hoarded power,
That girt the tyrant in his storied tower,
Has passed and faded like a dream of youth,
And riper eras ask for history's truth."
HOLMES.

CHINA AND ITS REVOLUTIONS.

In our preceding numbers we briefly pourtrayed the historical phases of the two great empires of the eastern world—Russia and Turkey,—the one the infant giant of modern times, and the other the withering carcase of tottering caducity;—the former the creation of the last 200 years, and the latter a vast military power of twelve centuries' duration, which has passed through the two great phases of national history—its rise and its zenith—and is rapidly approaching to the third stage—its fall and extinction. Such are the ethnical lessons which our pages present to the students of history.

We have now to enter upon the history of a people, the most ancient in the world, whose annals are lost in the deep mists of 5000 years. The empire of China has been a mystery for ages. Vast in the extent of its territory, and overflowing to redundancy in its population, before the time of Marco Polo we knew little more about it than we did of the aborigines of Central Africa or the Red Indians of the far west. "Exclusive in all its dealings (says a contemporary writer) it has repelled curiosity, baffled inquiry, and withstood all the approaches of other nations towards intercommunication." The result is that China stands alone—an anomaly among the nations—neither civilized nor barbarous, neither stagnant nor progressive. Limited by a narrow range of ideas and a low intellectual development, the Chinese have advanced in the arts, but not in the philosophy of life. Their traditions are vague, and their religion a confused and varying superstition; their commerce limited to the frequenters of their own ports, and their literature—such as it is—without beginning or end, purpose or point—the transcript merely of the floating prejudices of the day. Within its million of square miles, and among its three hundred millions of people, it finds its own world, and knows little, and cares less, for the great unexplored world beyond it. No other empire is so idiosyncratic. Her national phase is unique as it is grotesque.

But the entire tendency of the age throughout the civilized world is against isolation; and to this genius of our epoch, China, like the rest of the world, must ultimately yield. The very force of circumstances will soon revolutionize the empire. At the present moment a religious movement is at work; and because it is religious, irrespective of its truth or falsehood, it will stimulate the energies and passions of that people, and travel from one to another like an epidemic. From Canton to Pekin—from Nankin to Bampo—the fury of religious zeal will be felt.

The insurgents, who have now possession of Nankin and Amoy, have adopted the ancient banner of Christian victory—"EN TOYTΩ NIKA"—and under its inspiring auspices they cannot fail to be eventually triumphant.*

The great empire of China being thus inevitably destined, ere long, to be the theatre of great events, a deep interest must necessarily be created in the minds of all historical readers and ethnical students, to learn something of the general history of this ancient people.

As we have already said, the annals of China are the most ancient in the world. The dynasties of Yu and Chin, if there is any credit due to their records, are long anterior to Nimrod of the Assyrians, or Menes of the Egyptians. Twenty-six dynasties of kings (or royal families) are recorded in the Chinese history; and the whole number of sovereigns from Yu to Taukwang is 235 or 243, commencing with Fuh-hi, during a period of 4699 years, from B.C. 2852 to A.D. 1847. This gives to each monarch an average of $19\frac{1}{3}$ years. If the computation commence with Yu, the time comprised in the Chinese monarchies gives 162 years to each dynasty, and an average of $17\frac{1}{4}$ years to each reign.

It is interesting to collate these computations with Egyptian history, which, though perhaps not so ancient as the Chinese, is better authenticated by contemporary authorities—especially the Hebrews and the Greeks. From B.C. 2715, when Menes founded the first Egyptian dynasty, to B.C. 331, a period of 2384 years, Manetho reckons thirty-one dynasties, and 378 kings, which is 77 years to each family, and only $6\frac{1}{2}$ to each reign.

To draw a comparison with our own country, "parvis componere magna," in England, during the 771 years, from William the Conqueror, in 1066, to Victoria, in 1837, there have been 34 sovereigns, averaging $22\frac{2}{3}$ years to each reign; and about the same average exists in the different states of Europe.

In our brief review of Chinese history we shall endeavour to methodize our materials, by introducing every important event or change of dynasty in chronological succession, and synchronize them, as far as practicable, with the leading epochs of Scriptural or classical history. The following will constitute the leading points :—

1*st*, Mythological history; 2*nd*, Dates compared with the Old Testament; 3*rd*, The establishment of the Chinese people; 4*th*, The five sovereigns, Fuh-hi and his successors; 5*th*, The three dynasties of Hia, Shang, and Chau; 6*th*, Tsin, the builder of the great Wall; 7*th*, Modern history—Han, Tang, and Sung dynasties; 8*th*, The Mongol conqueror, Kublai; 9*th*, The Ming dynasty; 10*th*, The Mantchus Sovereigns, who overran China.

China has her mythological history like other countries, and it should be separated from the more recent; and received, as her own historians regard it, as the fabrication of subsequent times. She also has her ancient history, whose earliest dates and events blend confusedly with the mythological, but gradually grow more credible and distinct as they come down the stream of time to the beginning of modern history.

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* In the "Lettres Edifiantes" there are many curious details respecting the founding of those religious missions in China, which are now, apparently, producing the fruit of revolution. We there find narratives of the adventures of those fearless and pious men who, while mediæval darkness had not yet utterly withdrawn from Europe, penetrated to the remotest valleys of Asia, and erected crosses over thousands of hamlets in countries confounded by popular belief with the half-fabulous Cathai, and the dominions of the mythical Prester John. They built little churches in that wonderful and beautiful cluster of islands starring the sea between New Guinea and the Malayan Archipelago; they spread their enterprise from the coast of Malabar to the coast of Tonquin; they baptized in Zebu, and until an immoderate and incautious zeal betrayed them, increased in honour and influence among the proselytised populations of Japan and the Kurile Group. But nowhere were the endeavours of these missionaries more early and persevering than in the distant provinces of China. Nor was their success incommensurate, though the horizon of European speculation closed upon them, so that for ages they laboured alone, and scarcely noticed. Influences the most hostile oppressed them; the successors to the dynasty of Ming, jealous of their moral power, withheld encouragement from them, and their work went on in the face of many perils and difficulties. Persecution, however, only inspired those missionaries—martyrdom exalted them. The one they have defied, and the other they have suffered to this day with heroic constancy. No force could coerce them into an abandonment of their holy design; no corruption could conciliate them to idolatry. Christian churches, therefore, have never become extinct in China, but have flourished until the name of Christ is known and venerated throughout the whole of its vast extent.

Chinese mythological history ends with the appearance of **Fuh-hi**, and their chronology should not be charged with the long periods antecedent,—varying from forty-five to five hundred thousand years,—for the people themselves do not believe this duration.

In the Chinese annals the accession of a Fuh-hi is placed B.C. 2852, or eight years after the death of Enos, 1152 years after the creation, and 508 before the deluge, according to the common received chronology of Usher. The weight of evidence, which the latter chronological examinations of Hales has brought to bear against the common period of 4004 years prior to the Advent, is such as to cast great doubt over its authenticity, and lead to the adoption of a longer period, in order to explain many events, and afford time for many occurrences which otherwise would be crowded into too narrow a space. Chinese chronology, if it be allowed the least credit, corroborates the results of Dr. Hale's researches, and particularly so in the data of Fuh-hi's accession.

Fuh-hi and his seven ancestors are stated to have reigned 747 years, averaging 93 each. Those who follow Usher consider these monarchs, if they ever had an existence, to be Chinese travesties of the eight antediluvian patriarchs, and Marquis d'Urban has gone so far as to write what he calls the Antediluvian History of China, collecting all the notices history affords of their acts.

The common chronology brings the deluge about thirteen years after the accession of Yau, and the death of Shun, the last of the eight, B.C. 2205, or twenty-five years after the confusion of tongues. According to Hales, the last epoch is 112 years before the call of Abraham; and these eight Chinese monarchs are therefore contemporaries of the patriarchs, who lived between Shem and Abraham, commencing with Salah, and ending with Nahor.

To **Shinnung**, *i. e.* "Divine husbandman," and **Hwangti**, *i. e.* "Yellow Emperor," are ascribed many valuable inventions. The Chinese annalists fill up the reigns of those chiefs, and their successors, down to the time of Yau, with a series of inventions and improvements in the arts of life and good government, sufficient to brin society to that degree of comfort and ord they suppose consonant with the charact of the monarchs.

The establishment of the Sexagena Cycle, in the sixty-first year of **Hwangti** reign, eighty-two years after the death Arphaxad, and about that time before t confusion of tongues, is a remarkable r cord; and although it would have bee easy, as many suppose was done, to hav antedated it at some subsequent period, i order to impose upon themselves with th belief of antiquity, no arguments or fac are adduced to prove that such was t case.

Three reigns, averaging eighty year duration, intervened between that Hwangti and the celebrated Yau; but n records have come down of the history the rulers, except that they lived and die They were all elected by the people, muc as were Shamgar, Jepthah, and other judg in Israel, and probably exercised simil sway. The reigns and characters of Ya and Shun have been immortalised by Cor fucius.

A tremendous deluge occurred durin the reign of Yau, B. C. 2293, caused, it said, by the overflowing of the rivers in th north of China. Those who place th Noachic deluge B. C. 2348, regard this a only a different version of that event: th variation of fifty-five years being unimportant. M. Klaproth, who favours th septuagint chronology, says it is nearl synchronous with the deluge of Xisuthru B. C. 2297.

The records in the Shu King of Yau an Shun, and their successor Yu the Grea who began to reign B. C. 2205, are longe than those of any other persons who live prior to Abraham. Those who follow Ushe regard Yu as being the leader of the fir band of colonists from the west after th deluge, 139 years before.

Chinese historians supply many detail regarding the conduct of Yu and Kie Kwei, the first and last princes of the hous of **Hia**; all the credible particulars of whic are taken from the classics, particularly th "Book of Records."

The accession of Yu, of the ancien dynasty of **Hia**, forms a remarkable er in Chinese history. The throne, whic hitherto had been more or less electiv ecame from this period hereditary in the ldest son, with only those occasional and iolent interruptions to which every de- potic government is liable. The national nnals, too, assume a more regular and uthentic shape, the reigns of the sove- eigns being at the same time reduced to a robable duration.

The Shang dynasty began B. C. 1766, or bout 120 years before the Exodus, and maintained an unequal sway over the feu- al states composing the empire for a period f 644 years. Its first monarch, Chingtang, s reputed to have paid religious worship to hangti, the Supreme Ruler, under which ame, perhaps, the true God was intended.

The names of Chausin and Tanki are ynonymous in the Chinese annals for very thing cruel and licentious, as Nero nd Messalina are in Roman history; and he "Book of Records" dwells largely on heir horrible crimes and debauchery, pparently in order to exculpate the con- uct of Wu-wang, who dethroned them, nd founded the Chau dynasty.

Wu-wang, the Martial King, the founder f the Chau dynasty, his father Wau- Vang, and his brother Duke Chau, are mong the most distinguished men of an- quity, celebrated by their biographer, onfucius, for their erudition, integrity, atriotism, and inventions.

Wau-wang, the Prince of Chau, was rime minister to Taiting, the grandfather Chausin, but was imprisoned for his fide- ty. His son obtained his liberation, and e sayings and acts of both occupy a large ace in the Shu King. Duke Chau is re- ted to have invented the compass, about c. 1112, though others ascribe it to wangti, and survived his brother to be- me the director of the councils of his ephew.

No period of ancient Chinese history is ore celebrated among the people than that the founding of this dynasty, chiefly be- use of the high character of its leading en, who were regarded by Confucius as npersonations of everything wise and noble.

[Such is a brief review of the remote riods of Chinese history. In our next shall have to enter upon a more au- enticated and far more interesting por- n of her wonderful annals.]

RATIONAL RECREATIONS.

In explanation of the arithmetical problems, which appeared in page 94 of our last Number, we have received the following solutions :—

I.

Suppose two widows, Anne Jackson and Mary Dilk, not akin, to be left each with a son, and that Anne's son marries Mary, and Mary's son marries Anne; and that Anne's son has a son by Mary. Where Mary's son is the person that leaves the money. Here to his

				£	s.	d.
Father,	who is the same as his	son,	is left	666	13	3
Mother,		daughter,		666	13	3
Grandson,		brother,		666	13	3
				£1,999	19	9

II.

$$\text{From}\left\}\begin{matrix}\text{SIX}\\\text{IX}\\\text{XL}\end{matrix}\right\{\text{take}\left\}\begin{matrix}\text{IX}\\\text{X}\\\text{L}\end{matrix}\right\{\text{then}\left\}\begin{matrix}\text{S}\\\text{I}\\\text{X}\end{matrix}\right\{\text{will remain.}$$

III.

The greatest variety that can be in the number of hairs, is equal to the greatest number that any person has—viz., one person having but one, another two, another three, and so on to the greatest number; but as, by the supposition, there are still more persons, whatever number they may have, some one of the preceding must have the same. Hence the proposition is manifest.

IV.

$$5.5 + \tfrac{5}{5} = 6\tfrac{1}{2}.$$

V.

Two-thirds of SIX = IX or 9.
One-fifth of SEVEN = V or 5.
and $9 \times 5 = 45$, the number required.

VI.

Smith moved 200 yards backward with his face towards Thompson's, and Thompson 200 yards forward with his face towards Smith's.

VII.

$$1.25 \times 4 = 5.$$

VIII.

$$\frac{2}{2^{2+2}} \quad \frac{2-\frac{2}{2}}{2} \quad \frac{2}{2-\frac{2}{2}} \quad \frac{2^{2+2}}{2}$$

denoting $\frac{1}{8}$, $\frac{1}{2}$, 2 and 8 respectively, the common ratio being 4.

EDUCATIONAL AND SCHOLASTIC MATTERS.

MATRICULATIONS IN THE LONDON UNIVERSITY.

At the matriculation examinations, which recently took place at this institution, there were 201 students who succeeded to the honour of becoming members of the university. A list of the successful candidates has been published, with the names of the colleges, schools, or institutions where they have been educated. The greatest number of students, however, are those who belong to no particular institution, but who are entered in the list as having been educated under *private tuition*, or by *self-tuition.* These amount to 39; while those belonging to King's College, near Somerset House, amount to 26; and of University College, Gower Street, to 26.

The following enumeration of successful candidates will show the statistics of collegiate and scholastic learning in various parts of the country; and we hope that the unendowed schools and institutions will be alive to the recommendatory advantages offered by matriculation and graduation at the University of London:—Owen's College, Manchester, had 7 successful candidates; Stonyhurst College, 7; New College, London, 6; Airedale College, 5; Queen's College, Birmingham, 5; Brecon College, Brecknock, 4; Manchester New College, 4; St. Mary's College, Oscott, 4; Baptist College, Bristol, 3; Cheshunt College, Herts, 3; St. Peter's College, Prior Park, 2; St. Gregory's College, Downside, 2; Rotherham College, 2; Horton College, 1; Spring Hill College, Birmingham, 1; Western College, Plymouth, 1; Queenwood College, Hants, 1; Stepney College, London, 1; St. Patrick's College, Carlow, 1; Hackney Theological Seminary, 3; Wesleyan Collegiate Institution, Taunton, 1.—Of schools, we find the following successful candidates:—University College School, Gower Street, 5; Mill Hill Grammar School, 6; City of London School, 2; Amersham Grammar School, 2; Hull School of Medicine, 1; St. Paul's School, London, 1; King's College School, London, 1; Chorlton High School, 1; Blackheath Proprietary School, 1; Sleaford Grammar School, 1; Bruce Castle School, Tottenham, 1; King's School, Rochester, 1; Leatherhead Grammar School, 1; Truro Grammar School, 1; St. Peter's Collegiate School, London, 1; Western Grammar School, London, 1; Clewer House School, 1; Cambridge House School, Hackney, 1; St. Alban's Grammar School, 1.

NORMAL SCHOOLS OF THE UNITED STATES.

Normal schools, for the training of popular school teachers, are a new feature in America, and have been introduced in imitation of the plan pursued in European countries. The first question of their introduction was raised in 1825, but no institutions of the kind were established until a much later date. Even at the present time they are but few in number, and consequently quite insufficient for the training of the number of teachers required. At present the greater number of popular school teachers receive their education through other means. Besides the indirect and obvious means for this purpose, there are other direct ones, of which the most important are the *Teachers' Associations*, or meetings of the teachers of smaller or larger territorial divisions, for discussing matters connected with education, and more particularly the *Teachers' Institutes.* The teachers' associations in the cities meet in some cases once a week or once a fortnight; those which are composed of members who gather from more distant localities generally do not meet more than two or three times in a year. The teachers' institutes may be considered as a kind of temporary normal schools, opened in each county during the common school vacations, generally during one or two weeks in each year. The common school teachers assemble in these institutes for the purpose of receiving instruction in matters relating to the art of tuition and to discipline, from persons especially selected for this charge by the highest school authority in the State, and who are bound, after the expiration of their term of office, to give a report to the State authority. It is not unusual for the State Superintendent, or (as in Massachusetts) the Secretary of the Board of Education, to be present at these meetings. It is common for the inhabitants in the localities where these teachers' institutes are held, to provide, gratuitously, board and lodging for the visitors, besides a room in which the meetings may be held. In many places the travelling expenses incurred by the teachers are either entirely or partially borne by the State. The education thus provided is open to a boy or a girl in any part of the States in which they may be located; for the girls share the instruction of the primary schools, in common with the boys, and there are high schools exclusively for girls.

STATISTICS OF EDUCATION AT CARLISLE.

The city of Carlisle, with a population of 30,000, possesses 9 public day-schools for the humbler classes, entrance to which is either gratuitous or at a merely nominal charge. In these there are at this time 1,853 scholars, averaging about 206 to each, and being above 6 per cent. of the entire population. There are, besides, 8 public Sunday-schools, numbering in all 1,190 scholars, and averaging about 149 to each. In the city, there are also 14 public literary institutions,—libraries, news-rooms, and both combined—of which three are for the middle and wealthier classes, at a charge of a guinea a year or more to each member; and 11 for the humbler classes, of which 2 are at the rate of twopence, and 9 at a penny a week. Of those at twopence, the Mechanics' Institute (chiefly frequented by clerks, assistants, and apprentices to shopkeepers) has the lion's share of public support, is of many years' longer standing than its humbler colleagues, numbers 630 members, and has a library of 3,500 volumes, with a news-room containing 3 daily, and 14 weekly papers, 6 quarterly and monthly, and 12 weekly periodicals. The Temperance News-room, at the same charge of twopence a week, is of six years' standing, has 98 members, 87 volumes, 4 daily and 10 weekly papers, and 4 magazines. Of the 9 rooms, at a penny a week, 5 present a feature of peculiar interest, being entirely under the management of working men; these 5 genuine working men's reading-rooms give a total of 609 members, averaging 122 to each institution; have 2,067 volumes among them, at an average of 413 to each; have 6 daily papers, or more than one a-piece; have 48 weekly papers among them, or nine a-piece; and 14 monthly and 41 weekly periodicals among them, or 3 and 8 respectively to each. Of the remaining 4 rooms, at a penny a week, the superintendence rests with others than working men; these include 429 members, and average 107; with 1,709 volumes in all, averaging 427 each; 5 daily and 21 weekly papers, being respectively 1 and 5 to each; with 8 monthly and 17 weekly periodicals, giving 2 and 4 to each. The penny rooms, taken first alone, and then with the twopenny rooms, give the following totals—Members, 1,038 and 1,766; volumes, 3,766 and 7,363; daily papers, 11 and 18; bi-weekly and weekly papers, 69 and 93; quarterly and monthly magazines, 22 and 32; and weekly periodicals, 58 and 70.

SCULPTURES OF NINEVEH.

For revealing the secrets of these mystic treasures of distant ages, the public are indebted, not to the Professors of Oriental Literature in our great Universities, but to three individuals, whose antiquarian learning has been chiefly derived from self-tuition and assiduous application. Major Rawlinson was a cadet in the East India Company's service; and, when he first traced the cuneiform inscriptions upon the Behistun rock, he sent his tracings home, that they might, before publication, be submitted to a clerk of the East India House, London—a modest man of the name of Norris, of whom nobody knew anything, yet whose great knowledge actually enabled him to discover, though he had never seen the Behistun rock, that Rawlinson, who had been in constant communication with the monument, had not copied the puzzling inscriptions with proper exactness. Rawlinson, at the instigation of the East India House clerk, compared his copy again with the original, and found that Mr. Norris was right. To make the learning of these two self-taught men of any avail, it was necessary that a third should supply material for the exercise of their ingenuity and persevering skill. A lawyer's clerk came to their help. Austen Layard (whose fame is now too well known to require comment), if he ever studied Oriental antiquities at all in his youth, pursued the knowledge under difficulties in the office of his uncle, a solicitor of London.

NATIONAL SYSTEM OF EDUCATION IN IRELAND.

In our last number we mentioned the resignation, as Commissioners, of Dr. Whateley, Ex-Chancellor Blackburne, and Baron Greene. Since then, the Board of National Education have appointed the Right Rev. Dr. Higgin, Bishop of Limerick, Mr. J. Hatchell, and Mr. Longfield.

PORTMAN NATIONAL SCHOOLS, ST. MATTHEW'S, MARYLEBONE.

The foundation-stone of these schools, situated in Salisbury Street, Edgware Road, was laid on the 1st inst. by the Rev. R. F. Spencer, LL.D. These schools are designed by Dr. Spencer to educate 300 boys and 300 girls in connection with the splendid church of St. Matthew's, having 1,400 free sittings. In the sixth week of their existence the day schools numbered 185 on the books, having commenced with 37; and the Sunday schools 230, having commenced with 70 only.

ASTRONOMY.

Some important telescopic discoveries have been recently made by Mr. Lassell, of Liverpool, in the distant planets of the celestial regions, especially Saturn, Uranus, and Neptune. His wonderful telescope, of twenty focal feet, was transported to Malta, for the sake of taking advantage of the translucent atmosphere of that beautiful climate; and he has been able to observe the first and second satellites of Saturn very distinctly. On the body of Saturn itself he has been able to discern two red-coloured bands, and three of a neutral, or greenish-blue colour. He has found, also, the two new satellites of Uranus. Mr. Lassell, from being a merchant, has become an amateur astronomer, and has himself constructed his magnificent telescope.

GEOGRAPHY.

The Russian Government is about to have measured the degrees of the meridian, from the North Cape, in 72½° north latitude, to the mouth of the Danube, in 45½° of the same latitude—that is, on a line which traverses Europe in its whole length, and forms about a fourteenth part of the entire circumference of the earth. This measurement will exceed by three degrees the largest ever before executed—that which the English carried from the Himalaya to the southern point of British India.

THE EDITOR AND HIS CORRESPONDENTS.

Chinese Invention of Paper. H. W.—The Chinese affirm that eighteen centuries ago they discovered the secret and means of manufacturing paper. In the first century of the Christian era, during the Han dynasty, a mandarin, who was attached to the emperor's court, and whose name was Sai-lun, discovered paper making. Tradition affirms that this mandarin took the bark of trees, pieces of old silk, and hempen cloth, and boiled them down until they came to the consistence of glue, or paste; he then spread the mass in thin layers upon the earth, and the sun's rays dried up the moisture, leaving a thin compact substance. Thus was the first paper made. Shortly afterwards, the means were discovered by which a smooth surface was given to it.

Art of Memory. N. RICHARDSON.—PHRENOTYPICS is but another name for "Memoria Technica," "Mnemonics," or the art of artificial memory, and is formed from the two Greek words, *φρηνος τυποι* (types of the mind). There are various systems which have been published and taught, the one best known being that of Dr. Grey. There are, however, great objections to them all; for the difficulty of remembering the objects with which events or names are to be associated, is often much greater than the effort required by the ordinary memory. The principles of every system of Phrenotypics, or Mnemonics, is nearly the same. It is to select a number of objects which, whether of themselves, or by reason of the order of selection, are more easily remembered than those which it is our object to remember, and to associate in our minds each one of the latter set with some one of the former. One of the simplest systems of Mnemonics is the plan which used to be resorted to by the ancient orators, of connecting, in their minds, the different parts of a speech with different parts of the building in which it was delivered; and the different systems which have been put forth in later times are only more complex specimens of the art which was put into practice by the ancient orators and rhetoricians.

CHARLOTTE WOOD (of Pimlico) "wishes to be informed whether a person of nineteen years of age is too old to commence learning French." Certainly not. At that age the strength of memory and the acquisitive faculties are approaching their zenith, and are then highly favourable to the successful study of any language. Cato did not commence the study of the Greek language before sixty, and he proved a tolerable proficient. With respect to pronunciation, a living teacher is necessary; but there are so many clever ones to be met with, that it would be invidious to name one in particular. The grammatical part of the language can be successfully acquired from the French lessons in the FAMILY TUTOR.

Pictures on Glass. T. SQUIRES (of Warwick).—Pictures cannot be so easily transferred to, or printed on glass, as our correspondent imagines. If he wishes to acquire the art of drawing on glass, he must first make a preparation of ground lamp-black, mixed with gum-water and some common salt. Then with a pen or hair pencil, draw the design on the glass, and afterwards shade and paint it with any colour most agreeable. As to the preparation of the colours, there are various modes, to be varied according to the nature of the pigments used. For instance, the colour for the ground is prepared by taking iron filings and Dutch yellow beads, equal parts; if a little red is wanted, add copper filings. With a steel mullar grind these together. Then add a little gum arabic, borax, common salt, and clear water. Mix these with a little fluid, and put the composition in a phial for use. For the preparation of a blue-purple, make a compound of lake and indigo, ground together with gum and salt water. For green, mix the above with a proportionate quantity of gamboge; and for yellow, grind gamboge with salt and water only.

J. H. M. (of Leeds) wishes to learn "what number of volumes will complete the FAMILY TUTOR?" We believe a similar question was asked of the editor of the "Gentleman's Magazine" a century ago; and the volumes of that celebrated periodical are not yet completed! There is no reason why the same destiny should not await the FAMILY TUTOR.

J. C. JONES.—The pronunciation of Kossuth is *Kossoot;* of Mazzini, *Matzeene;* of Magyar, *Maggear;* and of Gavazzi, *Gavatzee.* In the other names you have enumerated there can be no difficulty.

A TYRO.—The tables are correct. There are only 12 oz. of gold to a pound; 100 lbs. to 1 cwt.; and 20 cwt. to a ton.

H. WINDLE.—The inflections of the moods of verbs do not properly come under the head of Syntax, but rather under "Inflection of Words," which is properly a division of the Etymology of Grammar; and in our first volume, under this head, our correspondent will find the grammatical formulæ and proper use of the Conditional or Subjunctive mood.—2. You will obtain every information necessary in the "Illustrated Twopenny Schoolbooks," by applying to the publishers, whose names are attached to the advertisements.

NATURAL PHILOSOPHY.

Second Division.

CHAPTER XLII.—(*Continued.*)

OF POLARIZED LIGHT.

Polarization by Refraction—Application of the Undulatory Theory—The Polariscope.

When it is required to polarize light by refraction, a pile of several plates of thin glass is used, for polarization from a single surface is incomplete.

On the undulatory theory we can give a very clear account of all these phenomena. Common light originates in vibratory movements taking place in the ether; but it differs from the vibrations in the air which constitute sound in this essential particular that, while in the waves of sound the movements of the vibrating particles lie in the course of the ray, in the case of light they are transverse to it. This may be made plain by considering the wave-like motions into which a cord may be thrown by shaking it at one end, the movement being in the up-and-down or in the lateral direction, while the wave runs straight onward. The ethereal particles, therefore, vibrate transversely to the course of the ray. But then there are an infinite number of directions in which these transverse vibrations may be made: a cord may be shaken vertically or laterally, or in an infinite number of intermediate angular positions, all of which are transverse to its length.

Common light, therefore, arises in ethereal vibrations taking place in every possible direction transverse to the path of the ray; but in polarized light the vibrations are all in one plane. Thus, in the case of the *tourmaline*, when a ray passes through it all the vibrations are taking place in one direction, and therefore the ray can pass through a second plate placed symmetrically with the first; but if the second be turned a quarter round the vibrations can no longer pass, in the same way as a sheet of paper, *c d*, Fig. 257, may be slipt through a grating, *a b*, while its plane coincides with the length of the bars; but can no longer go through when it is turned as at *e f*, a quarter round.

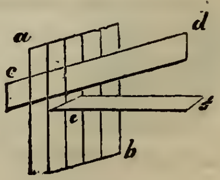

Fig. 257.

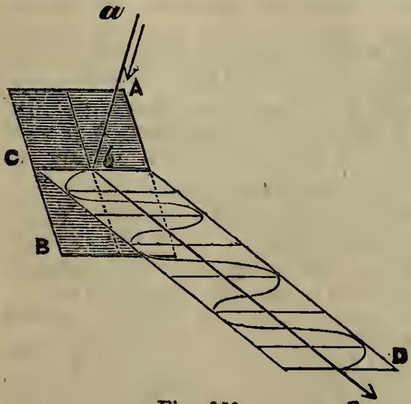

Fig. 258.

Again, in the case of polarization by reflexion, let A B, Fig. 258, be the mirror on which a ray of common light, *a b*, falls at the proper angle of polarization, and is reflected in a polarized condition along *b c*. C D will be the plane in which the ethereal particles vibrate after reflection, and the curve line drawn on it may represent the intensities of their vibrations.

So, too, in Fig. 259, we have an illustration of polarization by refraction. Let A B be a bundle of glass plates, *a b* the incident, and *c d* the polarized ray; the plane C D at right angles to the plates is the plane of polarization, and the curve drawn on it represents the intensities with which the polarized particles move.

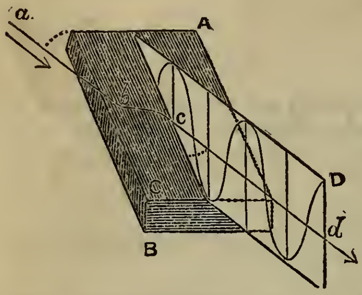

Fig. 259.

In every instance the plane of polarization is perpendicular to the planes of reflexion and refraction.

The polariscope is an instrument for exhibiting the properties of polarized light. There are many different forms of it: Fig. 260 represents one of them. It consists of a mirror of black glass, *a,* which can be set at any suitable angle to the brass tube, A B, by means of a graduaded arc, *e;* it can also be rotated on the axis of the tube B A, and the amount of that rotation read off on the graduated circle *b.* At the other end of the tube there is a second mirror of black glass, *d,* which, like *a,* can be arranged at any required angle, and likewise turned round on the axis of the brass tube, A B, the amount of its rotation being ascertained by the divided circle, *c.* Sometimes instead of this mirror of black glass a bundle of glass plates in a suitable frame is used. The instrument is supported on a pillar, C.

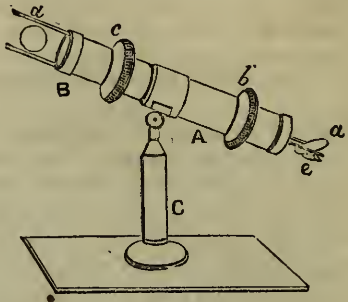

Fig. 260.

The fundamental property of light polarized by reflexion may be exhibited by this instrument as follows:—Set its two mirrors, *a* and *d,* so as to receive the light which falls on them at an angle of 56°. Then, when the first, *a,* makes its reflexion in a vertical plane, the light can be reflected by *d* also in a vertical plane, upward or downward. But if *d* be turned round 90°, so as to attempt to reflect the ray to the right or left in a horizontal plane, it will be found to be impossible, the light becoming extinct and in intermediate positions. As the mirror revolves the light is of intermediate intensity.

CHAPTER XLIII.

ON DOUBLE REFRACTION AND THE PRODUCTION OF COLOURS IN POLARIZED LIGHT.

Double Refraction of Iceland Spar—Axis of the Crystal—Crystals with two Axes—Production of Colours in Polarized Light—Complementary Colours produced—Colours depend on the Thickness of the Film—Symmetrical Rings and Crosses—Colours produced by Heat and Pressure—Circular and Elliptical Polarization.

By double refraction we mean a property possessed by certain crystals, such as Iceland spar, of dividing an incident ray into two emergent ones. Let R *r,* Fig. 261, be a ray of light falling on a rhomboid of Iceland spar, A B C X, in the point *r,* it will be divided during its passage through the crystals into two rays, *r* E, *r* O, the latter of which follows the ordinary law of refraction, and therefore takes the name of the ordinary ray; the former follows a different law and is spoke of as the extraordinary ray.

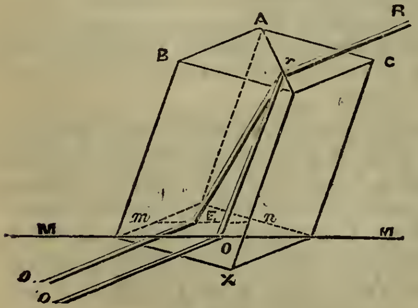

Fig. 261.

Objects through such a crystal appear double. A line, M N, on a piece of paper viewed through it is exhibited as two lines, M N, *m n,* the amount of separation depending on the thickness of the crystal. The emergent rays E *e,* O *o,* are parallel after they leave the surface X.

A line drawn through the crystal, from one of its obtuse angles to the other, is calle the axis of the crystal, and if artificial planes be ground and polished as *n m*, *o p*, perpendicular to this axis, *a b*, Fig. 262, rays of light falling upon this axis or parallel to it do not undergo double refraction.

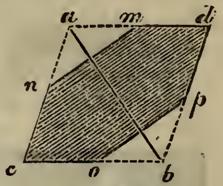

Fig. 262.

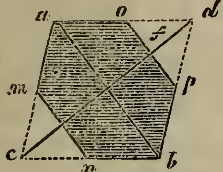

Fig. 263.

Or if new faces, *o p*, *n m*, Fig. 263, be ground and polished parallel to the axis *a b*, a ray falling in the direction *d f* also remains single.

But if the refracting faces are neither at right angles nor parallel to the axis, double refraction always ensues.

While Iceland spar has only one axis of double refraction, there are other crystals, such as mica, topaz, gypsum, &c., that have two. In crystals that have but one axis there are differences. In some the extraordinary ray is inclined from the axis; in others toward it, when compared with the ordinary ray. The former are called *negative* crystals, the latter *positive.*

The explanation which the undulatory theory gives of this phenomenon in crystals having a principal axis is, that the ether existing in the crystal is not equally elastic in every direction. Undulations are therefore propagated unequally, and a division of the ray takes place, those undulations which move quickest having the less index of refraction.

When the two rays emerging from a rhomb of Iceland spar are examined, they are both found to consist of light totally polarized, the one being polarized at right angles to the other. We have, therefore, several different ways in which light can be polarized —by reflexion, refraction, absorption, and double refraction.

When a crystal of Iceland spar is ground to a prismatic shape, and then achromatized by a prism of glass, it forms one of the most valuable pieces of polarizing apparatus tha we have. Such a prism may be used to very great advantage instead of the mirror of the apparatus, Fig. 260.

If a ray of polarized light is passed through a thin plate of certain crystallized bodies, such as mica or gypsum, and the light then viewed through an achromatic prism, or by reflexion from the second mirror of the polarizing machine, brilliant colours are at once developed. Thus, let R A, Fig. 264, be a ray of light incident on the first mirror of the polariscope, A C the resulting polarized ray, and D E F G be a thin plate of gypsum or mica. If, previous to the introduction of this plate, the two mirrors A and C be crossed, or at right angles to one another, the eye placed at E will perceive no light; but, on the introduction of the crystal, its surface appears to be covered with brilliant colours, which change their tints according as it is inclined, or as the light passes through thicker or thinner places. On further examination it will be found that there are two lines, D E and F G, which, when either of them is parallel or perdendicular to the plane of polarization, R A C, or A C E, no colours are produced. But if the plate be turned round in its own plane a single colour appears, which becomes most brilliant when either of the lines *a b*, *c d*, inclined 45° to the former ones, are brought into the plane of polarization. The former lines are called the neutral, and the latter the depolarizing axes of the film.

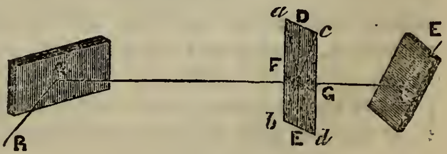

Fig. 264.

This is what takes place so long as we suppose the two mirrors, A C, fixed; but if we make the mirror nearest to the eye revolve while the film is stationary, the phenomena are different. Let the film be of such a thickness as to give a red tint, and be fixed in such a position as to give its maximum colouration, and the eye-mirror to revolve, it will be found that the brilliancy of the colour declines, and it disappears when a revolution of 45° has been accomplished; and now a pale green appears, which increases in brilliancy until 90° are reached, when it is at a maximum. Still continuing the revolution, it becomes paler, and at 135° it has ceased, and a red blush commences, which reaches its maximum at 180°; and the same system of changes is run through in passing from 180° to 360°; so that while the film revolves, only one colour is seen; but as the mirror revolves two appear.

If, instead of using a mirror, we use an achromatic prism, we have two images of the film at the same time, and we find that they exhibit complementary colours—that is, colours of such a tint, that if they be mixed together they produce white light. This effect is represented in Fig. 265.

That the particular colours which appear depend on the thickness of the films, is readily established by taking a thin, wedge-shaped piece of sulphate of lime, and exposing it in the polariscope. All the different colours are then seen, arranged in stripes according to the thickness of the film.

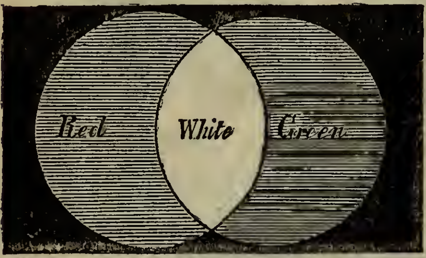

Fig. 265.

When a slice of an uniaxial crystal cut at right angles to the axis is used instead of the films in the foregoing experiment, very brilliant effects are produced, consisting of a series of coloured rings, arranged symmetrically, and marked in the middle by a cross, which may either be light or dark—Figs. 266, 267—light if the second mirror is in the proper position to reflect the light from the first, and dark if it be at right angles thereto.

In crystals having two axes, a complicated system of oval rings, originating round each axis, may be perceived, intersected by a cross. Figs. 268, 269, represent the appearance in a crystal of nitrate of potash; and in the same way other figures arise with different crystals.

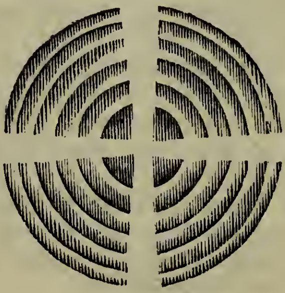

Fig. 266.

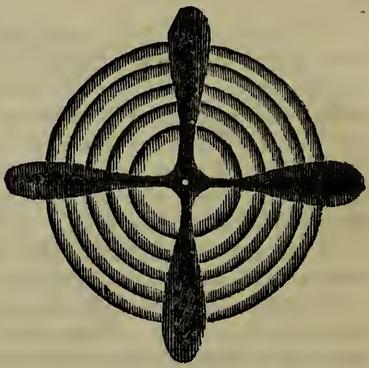

Fig. 267.

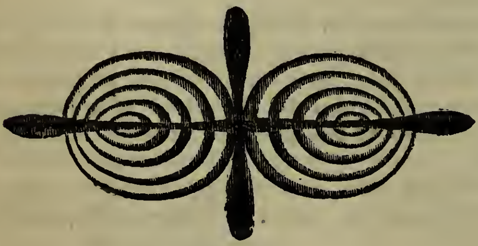

Fig. 268.

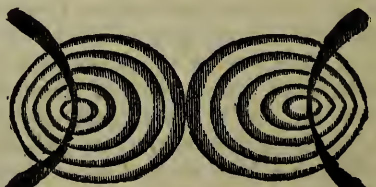

Fig. 269.

If transparent noncrystallized bodies are employed in these experiments, no colours whatever are perceived. Thus, a plate of glass, placed in the polariscope, gives rise to no such development; but if the structure of the glass be disturbed, either by warming it or cooling it unequally, or if it be subjected to unequal pressure from screws, then colours are at once developed; Figs. 270, 271. This property may, however, be rendered permanent in glass by heating it until it becomes soft, and then cooling it with rapidity.

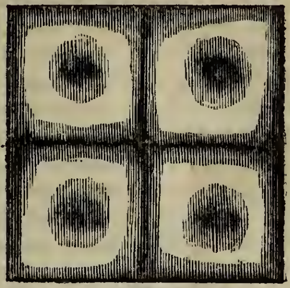
Fig. 270.

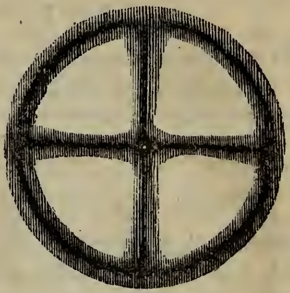
Fig. 271.

All the phenomena here described belong to the division of plane polarization; but there are other modifications which can be impressed on light, giving rise to very remarkable and intricate results: these are designated circular, elliptical, &c., polarization.

The mechanism of the motions impressed on the ether to produce these results is not difficult to comprehend; for common light, as has been stated, originates in vibrations taking place in *every* direction transverse to the ray; plane polarized light arises from vibrations in *one* direction only; and when the ethereal molecules move in circles they originate circularly polarized light, and if in ellipses, elliptical.

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ELEMENTS OF DRAWING TAUGHT IN PRIMARY SCHOOLS.

The government has of late years taken a great interest in promoting the study and practice of drawing in our Primary Schools of education; and Elementary Schools, in connexion with the Society of Arts, have been established in various localities. The object of the government and of the Society, in thus encouraging drawing, is "to give instruction in drawing simply as a language useful in every relation in life," with "reference rather to the power of expressing form by lines, than to any ornamental or other special direction of the studies."

It appears from Mr. Fletcher's Report on the Day Schools of the British and Foreign School Society (as published by the Council on Education for the year 1847), that drawing was taught in no fewer than seventy-three of the British schools, and in eight of these schools perspective drawing from objects was practised. Mr. Fletcher then expresses his opinion, that were it not for the expense (£10) of the necessary apparatus, model-drawing would be more general. The expense of the models is now, however, no longer an objection. The price of these essential aids to art-instruction has been gradually reduced, until a set of twelve models, including a stand to display them, may be purchased for the low price of 12s. Even this expense may be avoided by those who can handle mathematical instruments with sufficient accuracy to make the models of pasteboard—the circle and ellipse of course excepted. A correspondent of ours has had a set of this kind in use for nearly two years; they combine the advantages of whiteness of colour with lightness of weight. The cube is six inches square; the other figures are made of such proportions that they may be grouped so as to form a cottage, a lodge, a village church, or a round tower.

But to return to the elementary drawing schools. The plan of instruction adopted at these schools is founded on that of Francœur, or Butler Williams. The children begin by straight lines, and geometrical figures, and then proceed to imitate architectural, mechanical, and zoological sketches. The number of lessons, of two hours each, required to complete the course, is eighty. Reckoning the usual school-year of the middle and higher classes at forty weeks, this extremely useful course of instruction might be completed in two years, if only one lesson a week was given.

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LESSONS IN NATIONAL HISTORY.

No. IV.

> "The age of mystery, with its hoarded power,
> That girt the tyrant in his storied tower,
> Has passed and faded like a dream of youth,
> And riper eras ask for history's truth."
>
> HOLMES.

CHINA AND ITS REVOLUTIONS.

AMIDST all the great revolutions of China, and the numerous dynastic changes, we shall find that few, if any, have been founded on the principles of justice. They were mere mutations of masters, attended with more or less destruction of life, with no just appreciation of the rights of the subject, or the powers of the rulers. Yet every page of Chinese history is well calculated to convey to the student of history a valuable ethnical lesson, and to demonstrate the important fact, that dynasties, like nations, have their rise, their zenith, and their fall; and that, as each has been founded upon the energies, the wisdom, or the virtues of one distinguished individual, so has their ultimate annihilation resulted from the vices, imbecility, or tyranny of their successors; and a succeeding dynasty has been thus founded on the ruins of its predecessor—"Sic transit gloria mundi!"

The duration of the three ancient dynasties of HIA, SHANG, and CHAU (briefly adverted to in our last number), extends from the year B.C. 2205 to 249, from the time when Terah dwelt in Charran, and the sixteenth dynasty of Theban kings ruled in Egypt, down to the reigns of Antiochus Soter, and Ptolemy Philadelphus, and the translation of the Septuagint.

The HIA dynasty, founded by Yu the Great, existed 439 years, down to B.C. 1766, under seventeen monarchs. Among the contemporary events of importance are the call of Abraham, B.C. 2093; Jacob's flight to Mesopotamia in 1916; Joseph's elevation in Egypt, in 1885; and his father's arrival in 1863.

The SHANG dynasty began with Chingtang, and continued 644 years, under twenty-eight sovereigns, down to B.C. 1122. This period was characterised by wars among rival princes, and the power of the sovereign depended chiefly upon his personal character. The principal contemporary events were the Exodus of the Israelites in 1648; their settlement in Palestine in 1608; judgeship of Othniel, 1564; of Deborah, 1406; of Gideon, 1359; of Samson, 1202; and death of Samuel, in 1122.

The CHAU dynasty began with Wu-wang, and continued for 873 years, under 35 monarchs, down to B.C. 249, the longest of any recorded in history.

The sway of many of these monarchs was little more than nominal, and the feudal states increased or diminished according to the rigour of the monarch, or the ambition of the princes.

The contemporary events of those eight centuries are too numerous to particularise. The accession of Saul in 1110; of David, 1070; of Rehoboam, 990; taking of Samaria, 719; of Jerusalem, 586; death of Nebuchadnezzar, 561; accession of Cyrus, and return of the Jews, 551; battle of Marathon, 490; accession of Alexander, 235, &c. The conquest of Egypt by Alexander in 322, brought the 31st and last dynasty of her kings to an end, the first of which had begun under Menes about B.C. 2715, or 22 years after Shinnung began to reign.

Among the feudal states under the house of Chau, that of TSIN, on the north-west, had long been the most powerful, occupying nearly a fifth of the country, and its inhabitants forming a tenth of the whole population. One of the princes, called Chau-siang-wang, carried his encroachments into the acknowledged imperial possessions, and compelled its master, Tungchaukiun, the last monarch, to humble himself at his feet. Although, in fact, master of the whole empire, he did not take the title, but left it to his son, Chwangsiang-wang, who exterminated the blood royal, and annihilated the Chau dynasty, yet lived only three years in possession of the supreme power.

The son carried on his father's successes, until he had reduced all the petty states to his sway. He then took the name of Chihwang-ti (*i.e.* First Emperor) of the TSIN dynasty, and set himself to regulate his conquests and establish his authority by securing to his subjects a better government than had been experienced during the feudal times. He divided the country into 36 provinces, over which he placed governors, and went throughout them all to see that no injustice was practised.

This monarch, who has been called the Napoleon of China, was one of those extraordinary men who turn the course of events, and give an impress to subsequent ages. He made progresses through his dominions with a splendour hitherto unknown, built public edifices, opened roads and canals to facilitate intercourse and trade between the various provinces, and repressed the incursions of the Huns, driving them into the wilds of Mongolia.

In order to keep the Huns out effectually, Chi-hwang-ti conceived the idea of extending and uniting the walls which the princes of some of the northern states had erected on their frontier into one GRAND WALL, stretching across the empire from the sea to the desert. This gigantic undertaking was completed in ten years; and it has made the name of Chi-hwang-ti celebrated throughout the world, however ineffectual it was to preserve his frontiers.

The vanity of the new monarch led him to endeavour to destroy all records written anterior to his own reign, that he might be by posterity regarded as the first emperor of the Chinese race. Orders were issued that every book should be burned, and especially the writings of Confucius and Mencius, upon the feudal states of Chau, whose remembrance he wished to blot out. Not only were the books sought after to be destroyed, but nearly five hundred literati were buried alive, in order that no one might remain to reproach, in their writings, the First Emperor with having committed so barbarous and insane an act.

The dynasty of Tsin, founded in such cruelty and blood, did not long survive the death of Chi-hwang-ti; for his son was unable to maintain his rule over the half-subdued chieftains; and after a nominal reign of seven years he was overcome by Liu Pang, a soldier of fortune. Under the name of Kautsu, he became the founder of the HAN dynasty; and his accession is regarded as the commencement of MODERN CHINESE HISTORY. The number and character of its heroes and literati are superior to most other periods; and to this day the term "Son of Han" is one of the favourite names by which the Chinese call themselves.

The first fourteen princes of this dynasty reigned in Shensi; but Kwangwu removed the capital to Lohyang in Honan; for which reason he and his successors are called the EASTERN HAN dynasty. During the reign of Ping-ti (or the emperor Peace), the Prince of Peace, our Lord Jesus Christ was born in Judea—a remarkable coincidence, which has often attracted notice.

In the reign of Ming-ti, A.D. 65, a deputation was sent westward to India, where they found the doctrines and disciples of Budha, which they brought to China, and by their means disseminated and maintained this faith in the popular belief of the Chinese, and spread it eastward into Japan.

This monarch and his successor, Chang-ti, penetrated with their armies as far westward as the Caspian sea, dividing and overcoming the various tribes on the confines of the desert, and at the foot of the Celestial Mountains, and extending the limits of the monarchy in that direction further than they are at present. The Chinese sway was maintained with varied success until towards the 3rd century.

The period between the overthrow of the Han dynasty, A.D. 190, and the establishment of the EASTERN TSIN, A.D. 317, is one of the most interesting in Chinese history, from the variety of characters which the troubles of the times developed.

Liu Pang, founder of the HAN and EASTERN HAN dynasties, took the title of HAN after the name of his principality, and his family swayed the Middle Kingdom from B.C. 202 to A.D. 221, under 26 monarchs. The removal of the capital to Lohyang is assigned as the reason of the division into two dynasties.

During this bright period of Chinese history, the consolidation of the western world under the Roman emperors, and their conquests in Europe, Africa, and Asia, with the advent of Christ and establishment of his church, render this period highly interesting to the general historian.

The AFTER HAN DYNASTY began A.D. 211, and continued 44 years under two princes to A.D. 265.

The second Dynasty was founded by a general in the employ of Han, of the last house, who seated himself on the throne of his master A. D. 265. He possessed only the western and southern part of the country, and waged continual war with the Huns and petty states which still opposed his sway. Four emperors of this house held their sway at Lohyang during 52 years, till A.D. 317.

The EASTERN TSIN is the same house as the last; but Yuen-ti having moved his capital from Lohyang to Nankin, his successors are distinguished as the Eastern Tsin. Eleven princes reigned during a period of 103 years, down to A.D. 450.

Budhism was the chief religion at this time, and the doctrines of Confucius were highly esteemed.

During this period Constantine changed the capital of the Roman Empire, in 328; and the nations of northern Europe, under Attila, invaded Italy in 410.

The SUNG, or NORTHERN SUNG Dynasty, was founded by Liu Yu, who commanded the armies of Tsin, and gradually subdued all the opposing states. Displeased at the weakness of his master, Ngan-ti, he caused him to be strangled, and placed his brother, Kung-ti, upon the throne, who, fearing a like fate, abdicated the empty crown, and Liu Yu became monarch, under the name of Kautsu, A.D. 420.

Eight princes held the throne till A.D. 479, when Siau Tauching, Duke of Tsi, the prime-minister of the weak successors of Liu Yu, recompensed them as their ancestor had those of Tsin. But his dynasty was eventually overthrown by the Prince of Liang, A.D. 502.

To the LIANG Dynasty succeeded those of CHIN, SUI, and TANG; the last of which obtained the throne A.D. 618.

During the 287 years that the celebrated line of princes of the house of TANG held the throne, China was probably the most civilized country on earth; and the darkest days of the West, when Europe was wrapped in the ignorance and degradation of the Middle Ages, formed the brightest era.

The celebrated annals of the Tang dynasty, which constitute the most brilliant period of Chinese history, will be resumed in our next.

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PUBLIC SCHOOLS.—No. II.

BLUE-COAT SCHOOL, NOTTINGHAM.

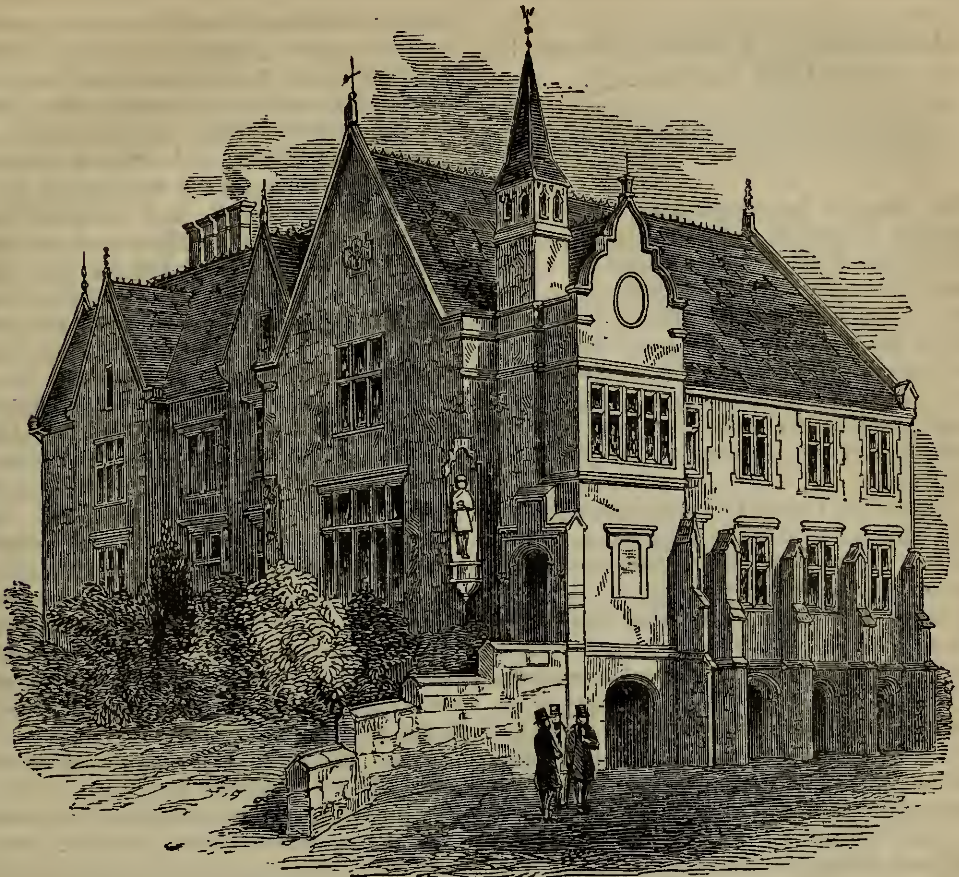
IN our last number we expressed our intention of occasionally introducing to the notice of our readers some of the leading public schools of the kingdom, and especially those of recent erection. It is therefore with great pleasure that we direct attention to the new BLUE-COAT SCHOOL, at Nottingham, which, to the credit of the inhabitants, has recently been erected on a scale commensurate with the important objects in view.

There are few towns in England which have made more rapid progress in architectural ornamentation and the general promotion of educational objects than this great mart of manufacturing industry; and it is a gratifying feature in our social polity to observe that the intellectual improvement of the masses keeps pace, in some measure, with the general prosperity of the community.

> "'Tis education forms the common mind—
> Just as the twig is bent, the tree's inclin'd."

The Free Grammar School of Nottingham was founded in 1513, and is under the control of the corporation; and though it may be said, from its antiquity, to take precedence of other local schools, still the BLUE-COAT SCHOOL has of late years assumed an importance which will soon place it in powerful rivalry with many of the leading scholastic institutions of the country. The school has been supported, for nearly a century and a half, partly by endowment and partly by subscription. The old school-house having become dilapidated, and in a measure unsuited to the requirements of the times, a new one has been lately erected upon the rising ground opposite the top of York Street, which forms a very conspicuous object from the Mansfield-road.

The style of architecture is of the Elizabethan period. It consists of two large and commodious school-rooms; the one for boys, and the other for girls; and of a dwelling house for the master and mistress. The boys' school is situated immediately above the covered portion of the play-ground, and consists of a room forty-two feet long by about twenty feet in width. It is well lighted, and has, on the whole, a handsome and cheerful aspect. On the story above the boys' school is situated that for the girls, twenty-one feet by nineteen; the committee, or class-room, occupying the remaining portion of the floor. The house is a very convenient one; it is three stories high, and contains two sitting-rooms and a commensurate number of bed-rooms, as well as a kitchen, sculleries, &c. In the



BLUE-COAT SCHOOL, NOTTINGHAM.

gable end, over the entrance into the school, is preserved a space for a clock. Higher up is an elegant little belfry.

In the turret on the Mansfield-road side, is placed a slab, bearing the following inscription:—"Blue-coat Charity School (founded A.D. 1706 by voluntary contributions, and further endowed with lands and tenements by Charles Harvey, A.D. 1711—John Labray, 1718—John Thorpe, 1720—Gilbert Beresford, 1747—and Joseph Peeke, 1763)—was removed, A.D. 1853, from the school-house on the High-pavement to this building.—T. C. Hind, Architect.''

The architectural façade of the building (with its bold Elizabethan gables, square mullioned windows, buttresses, and central turret) presents rather an imposing aspect, and is every way characteristic of the objects of the institution. In the niches in front of the edifice are statuettes of a boy and girl, in the school dress, carved in white Caen stone. Beneath each figure appears a scroll bearing the appropriate inscription—"EXCELSIOR."

This new school-house was opened with great ceremony on the 19th of July last, at which were present the Rev. J. W. Brooks (vicar of the parish) and some of the principal residents of the locality. In his address to the friends of the institution and the assembled scholars, the reverend gentleman observed that the inconvenience of the old school-house had been long felt and acknowledged; and it was a matter of great rejoicing that they had been enabled to provide so excellent a house as the one they had now assembled to open. He expressed his entire satisfaction and concurrence with the course of study pursued in the school, especially on account of the fact that the Holy Scriptures proved the main basis of the whole system of education pursued at this institution.

HISTORICAL REVIEW OF THE ENGLISH LANGUAGE.

"Words are the sole expounders of the mind,
And correspondence keep 'twixt all mankind."

The English language, like the English people, is derived from various originals. First comes the Celtic, the oldest of our contributors in words. That the great bulk of the inhabitants of the British Isles, prior to the dawn of history, were of Celtic origin, is generally agreed on. Who these Celts were, and whence they had originally come, are questions on which the learned have formed, and still continue to form, different theories.

One of the purest and most genuine dialects of the Celtic now extant is that spoken by the native Irish; from the remarkable agreement between the letters of whose alphabet and those introduced first by the Phœnician Cadmus into Greece, as well as from various religious rites and ceremonies connected with the Druidical system of religious belief, the somewhat plausible theory has been propounded, that the great Celtic branch of the human family was derived originally from the East.

"According to the view," says the Cabinet History of England, Ireland, and Scotland, "of some learned philologers, the very imperfections attributed to the Irish language—the predominance in it of gutturals, and the incompleteness of its alphabet—are both but additional and convincing proofs, as well of its directly Eastern origin as of its remote antiquity; the tongues of the East, before the introduction of aspirates, having abounded with gutturals, and the alphabet derived from the Phœnicians by the Greeks having had but the same limited number of letters which compose the Irish."

However the question be decided as to the origin of the Celts, it is certain that they themselves were found at the dawn of history in possession of the western extremity of Europe. In Gaul and Britain they were discovered by the Romans in such a state of disunion—one of the characteristics of a people divided into petty principalities—as enabled the latter speedily to accomplish their subjugation.

The Romans did not amalgamate so largely with the Britons as to change the characteristics of the latter. They rather despised them; they looked down on them as the first European settlers did on the several Indian tribes whom they subdued. The Romans held the country by *military* tenure. For the Saxons, comparatively at least, was reserved the more useful and permanent work of *colonizing* it, and thereby introducing such improvements as wholly to change the external aspect of the country, and lay the foundation, to a considerable extent, of our modern system of jurisprudence.

The pedigree of our modern English language, too, is traceable to theirs; for whilst we derive many of our English words from the ancient Celtic dialects, the Norman-French introduced subsequently to the Conquest, and also a great quantity from the Latin, it will be found, on examination, that the great majority of the most ordinarily used words are from an Anglo-Saxon original; and not only this, but that the system of laws, constituting our etymology and syntax, is Anglo-Saxon in all its essential characteristics.

From the Celtic we derive, as might naturally be expected, a great variety of geographical names for mountains, rivers, valleys, and other natural objects. More recently we have received from the antiquaries a few miscellaneous words, such as "bard," and "druid;" while such as "tartan," "plaid," "flannel," and others, owe their introduction to ordinary occasions. The number of words, however, derived in modern English from a Celtic origin cannot now be properly estimated.

The Celtic itself is so little critically understood, and the probability of the Anglo-Saxons having originally adopted, whether for convenience or conciliation, many Celtic words, is so strong, as to create a doubt as to whether or not many words, said to be deduced from a Saxon original, are not more radically deducible from the Celtic, from which the Saxon itself might have borrowed them; and, accordingly, many words, some of them certainly not Saxon, have been held to be Welsh, and to have been introduced in this manner.

The Celtic elements of the present English are reduced, by Professor Latham, into five classes.

1st. Those that are of late introduction, and cannot be called original and constituent parts of the language. Some of these are the words flannel, tartan, plaid, &c.

2nd. Those that are originally common to both the Celtic and Gothic stock. Some of these are brother, mother, &c.

3rd. Those that have come to us from the Celtic, but through the medium of another language. To these belong the words druid, bard, whose immediate source is Latin, but remote, Celtic.

4th. Celtic elements of the Anglo-Norman, introduced into England after the Conquest, and occurring in that language, as remains of the original Celtic of Gaul.

5th. Those that have been retained from the original Celtic of the island, and which form genuine constituents of our language. These latter are subdivided into three classes:—1st, Proper geographical names—as Thames, Kent:—2nd, Common names retained in the provincial dialects of England, but not in the current language—as *givethall*, meaning household stuff, and *gwlanen*, flannel:—3rd, Common names retained in the present language—as *basgawd*, basket; *berfa*, barrow; *botiom*, button; *bian*, bran; *crochan*, crockery; *crog*, crook.

Another large and very important element of modern English is the Latin introduced at various times, ranging from the first invasion of the Romans to the present day. Of the first period, the few words that remain may be called Latin of the Celtic period, and naturally relate to military affairs. To such belong the words *street*, from the Latin *stratus*, laid down; the terminations, *coln* from *colonia*, a colony—as in the word Lincoln; and *cest*, or *chester*, from *castra*, camps, as in Chester, Gloucester, &c.

To the second period belong such words as were introduced into England subsequently to the conversion of the natives to Christianity. They relate chiefly to ecclesiastical affairs. Of these are the words porch, from *porticus;* pall, from *pallium;* chalice, from *calix;* candle, from *candela;* cloister, from *claustrum;* and such like.

The words of the third period were introduced between the battle of Hastings and the revival of literature. Such words owe their introduction to the cloister, the universities, and, to some extent, to the courts of law.

The words in the English language, derived from Latin of the fourth period, were introduced between the revival of literature and the present time. They owe their origin to the productions of learned men, and form a large component part of our modern English.

Besides the Celtic and Latin elements of the language, we find the Danish to a very limited extent, and the Anglo-Norman more extensively supplying many words. Of these latter are terms relating to the feudal system, to war and chivalry, and many to law affairs—as the words, duke, court, baron, villain, warrant, esquire, challenge, &c., &c.

The chief element, however, of modern English is the Anglo-Saxon, which may be called the mother-tongue, in contradistinction to all the foregoing, which may be termed the foreign elements.

In the dictionaries of the English language, as it is now spoken, there are calculated to be about 38,000 words; and of these about 23,000 are reported to be traceable directly to a Saxon original; that is by a little less than the five-eighths of the whole number.

Another standard whereby to try the comparative strength of the seven elements has been found in the analysis of the authorised version of the Scriptures, and of fourteen popular writers in prose and verse, of whom the poet Spenser is the first, and Samuel Johnson the last.

Of the whole number of words examined, those that are not of Saxon origin make less than one-fifth, which would leave more than four-fifths as native—that is, derived from the mother-tongue, or Anglo-Saxon. "Let the present language of England," says Professor Latham, "consist of 40,000 words. Of these, let 30,000 be Anglo-Saxon, 5000 Anglo-Norman, 100 Celtic, 10 Latin of the first, 20 Latin of the second, and 30 Latin of the third period, 50 Scandinavian, and the rest miscellaneous; and we have the language considered according to the historical origin of the words that compose it."

The conquest of Britain by the Romans did not effect any change in the language thereof; the primitive tongue of the British isles obtaining universally throughout them during their whole tenure of the country. Even in the present day, dialects of that tongue—the oldest of all European tongues—the tongue which, whatever name it may be called by, according to the various and vague theories respecting it, whether Japhetan, Cimmerian, Pelasgic, or Celtic, is accounted generally to have been the earliest brought from the East, and to have been, therefore, the vehicle of the first knowledge that dawned upon Europe. Dialects of that tongue are spoken in several parts of England. Welsh, for instance, is spoken in Wales, Manks in the Isle of Man, Scotch Gaelic in the Highlands of Scotland, and Irish Gaelic in Ireland.

The removal of the seat of the Roman Empire to Constantinople led, as one cause amongst many, to its final dismemberment and downfall. The necessities of the state, and the incessant conflicts with the northern barbarians, rendered it impossible for the Romans to maintain such a military force in Britain as was required to keep the natives in subjection. And in A.D. 420, the Emperor Honorius formally released them from their allegiance, which they had professed for about 400 years. No longer overawed by the presence of the Roman legions, the Britons refused to submit to the authority of the provincial governors. The native chieftains began to quarrel amongst themselves for supremacy, the Picts and Scots poured in their devastating hordes from the north, and the whole country was involved in anarchy and bloodshed. In this state of things, Vortigern, one of the native chieftains, called in the aid of two brothers, Hengist and Horsa, Saxon freebooters, who had previously infested the eastern coast; and thus was laid the commencement of the first Germanic settlement in the island, about A.D. 450. Ebbsfleet, in the Isle of Thanet, is the spot where they landed, and the name they were called by was that of Jutes. Six years after they landed they had established the kingdom of Kent; so that the county of Kent was the first district where the original British was superseded by the mother-tongue of the present English introduced from Germany.

For centuries afterwards, Germanic tribes continued incessantly to take up their abode in the island; the ancient Britons and their language retiring gradually before them to the west. The accounts that have come down to us, however, relative to these settlers, and the incidents that arose out of their invasion of Britain, do not belong to authentic but traditional history; our earliest record thereof, that by Bede, having been written 300 years after the landing of the aforesaid Hengist and Horsa.

"About the year of Grace," wrote he, "445-446, the British inhabitants of England, deserted by their Roman masters, who had enervated while they protected them, and exposed to the ravages of Picts and Scots from the extreme and barbarous portions of the island, called in the aid of heathen Saxons from the continent of Europe. The strangers faithfully performed their task, and chastised the northern invaders; then, in scorn of the weakness of their employers, subjected them in turn to the yoke, and, after various vicissitudes of fortune, established their own power on the ruins of Roman and British civilization."

In A.D. 477, invaders from Northern Germany made the second permanent settlement in Britain. The coast of Sussex was the spot whereon they landed. The particular name by which these tribes called themselves was that of Saxons. Their leader was Ella. They established the kingdom of South Saxons; so that the county of Sussex was the second district where the original British was superseded by the mother-tongue of the present English introduced from Germany.

The third settlement of invaders from Germany occurred A.D. 495. They landed under their leader, Cerdic, on the coast of Hampshire, and, like the last-named invaders, were called Saxons. They established the kingdom of the West Saxons; so that the county of Hants was the third district where the original British was superseded by the mother-tongue of modern English.

The fourth settlement of the Germanic tribes was effected about A.D. 530, in Essex. The fifth, the precise date not being authenticated, was effected by the Angles in Norfolk and Suffolk.

The sixth settlement was accomplished by invaders from Northern Germany in A.D. 547. The south-eastern counties of Scotland, between the rivers Tweed and Forth, were the districts whereon they landed; and accordingly, in these parts respectively, in one after the other, was the original British language superseded by the mother-tongue of our present English, which is thus proved to be essentially a branch of the Teutonic,—the language which was spoken by the inhabitants of Central Europe immediately before the dawn of history, and which constitutes the foundation of the modern German, Danish, and Dutch. Introduced by the Anglo-Saxons in the fifth century, it gradually spread, with the people who spoke it, over nearly the whole of England, the Celtic shrinking before it into Wales, Cornwall, Ireland, and the north of Scotland, in like manner as the Indian tongues are now retiring before the advance of the British settlers in North America.

There is evidence, however, that the original British language was not so speedily extinguished by the introduction of the Anglo-Saxon as was at first generally supposed. The former, of course, experienced the degradation which the aboriginal inhabitants themselves experienced at the hands of their conquerors; but being the language of the people, and having numbers on its side, it necessarily held its ground for a considerable time, and only gave way step by step, or retired to other parts of the island, according as the invaders gained on or amalgamated themselves with the natives.

The Anglo-Saxon tongue itself was not cherished so enthusiastically at first by the literati amongst the Anglo-Saxons as to insure its universal and instantaneous spread. From the period of its first introduction, it underwent little or no change for nearly five centuries; the chief accessions which it received being Latin terms introduced by Christian missionaries.

Down to the middle of the seventh century, few comparatively of the educated writers composed in their own language, and Latin was regarded as exclusively adapted to the exigencies of literary composition.—(*To be continued.*)

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ON THE STUDY OF EUCLID.

IV.—THE PROPOSITIONS. BOOK I.

THE propositions of geometry are of two kinds—problems and theorems. A proposition is called a *problem,* when the thing proposed is an operation to be performed, a construction to be effected: its object is a practical result, to be brought about by a suitable disposal and combination of the elementary materials furnished by the postulates. A proposition is called a *theorem,* when the thing proposed is a truth to be demonstrated; and for this demonstration the elementary materials are furnished by the axioms. It usually happens, however, that the proof of a theorem requires the previous introduction of certain lines and constructions, and hence it is that Euclid commences his first book with problems instead of theorems: the only theorem that is quite independent of a problem is Proposition IV. I suppose Euclid considered it to be more systematic to introduce the problems, which he foresaw would be indispensable as soon as the fourth proposition was disposed of, at the beginning of the book, than to interpose them between propositions so closely related as the fourth and fifth.

Of the three problems thus found to be necessary to meet the demands of the subsequent theorems, the second is the only one which seems to require any comment. Beginners in general find it difficult; and are apt to consider that there is an unnecessary parade of geometrical apparatus exhibited to effect so simple a matter as the drawing of one straight line equal to another. There is no doubt that a mere mechanic would pronounce the proceeding a very round-about one: he would accomplish the business at once, by drawing A E at random; and then, having taken the length B C in his compasses, he would apply one foot at A, fixing it there as a centre, and with the other foot would cut off the required length A L; thus dispensing with all Euclid's machinery—the circles and the equilateral triangle. Now all this is very well for the purposes of the practical workman, who neither seeks nor expects rigid accuracy in his constructions; but you must remember that Euclid ignores compasses, and that the instrumental transference of one line to another is not warranted by any postulate. No one can take *accurately* any stipulated length in a pair of compasses; the limitation of his vision precludes his pronouncing, with perfect certainty, that he has got *exactly* the proposed length, neither more nor less; if the minute error, whether in excess or in defect, be only so small as to escape his senses, he cannot take cognizance of it;

and he not only practically, but from necessity disregards it. But without any additional postulate, Euclid shows you how the thing proposed may be done without the possibility of any error at all. In the ordinary editions of Euclid, I think justice is scarcely done to the process indicated. You are directed, first, to draw a line A E *longer* than B C, and are then shown how to cut off a part A L *equal* to B C. The ingenuity of Euclid's mode of proceeding would be more apparent, if no superfluity of length were at first introduced. It certainly seems a thing of much greater difficulty to draw a line from a point A, till a certain prescribed length be attained, and then, but not till then, to stop. I would therefore recommend you to leave the prolonging of D A to the very last; so that, having performed every other part of the construction, prolong D A, as a final step, till the prolongation reaches to the circumference of the outer circle. A line A L will thus have been drawn equal to B C, and there will be no excess of length to throw away. Perhaps I had better just go over in detail what I consider to be an improved version of the process.

From a given point to draw a straight line equal to a given straight line (see the diagram to Prop. 2, Book I.)

Let A be the given point, and B C the given straight line; it is required to draw from the point A a straight line equal to B C.

From A to B draw the straight line A B; and upon it describe the equilateral triangle D A B. From the centre B, at the distance B C, describe the circle C G H, and produce D B to meet it in G. From the centre D, at the distance D G, describe the circle G K L, and produce D A to meet it in L. *A L shall be equal to B C.*

As to the other two problems, the first and third, but little need be said; the directions given by Euclid for the construction of them are too clear and explicit to render further explanation necessary. It may be well, however, to invite your attention to two particulars in connection with Proposition I., which instructs us how to describe an equilateral triangle upon a given finite straight line. Some commentators object to the word *finite* as superfluous, considering the condition, "a *given* straight line," to imply that the *length* is fixed and determinate. But a line may be given in *position* only, without any limitation as to *length*, as in Proposition XI.; or it may be given in *length* merely, without any restriction as to *position;* thus the line to be constructed in Proposition II. is to have a given length, but is unrestricted as to position or direction. By "a given *finite* straight line," Euclid means a line of given length, and with given extremities; and if any objection at all is made, in reference to this word *finite,* I think it should be urged against the omission of it in Proposition II., rather than against the introduction of it in Proposition I. In the *first* proposition, I dare say Euclid thought it prudent, to prevent all cavil, to state explicitly that the extremities, A, B, are given; and that he did not consider it necessary to repeat this in Proposition II. Whenever a line is given in position merely, and restriction as to its length forbidden, Euclid characterises it as "a given straight line of unlimited length," as in Proposition XII.; but when it is matter of perfect indifference whereabouts the extremities are (position alone being all that we are concerned with), the terms "a given straight line" are those always employed, as in Proposition XXXI. A mere glance at this proposition will show you that the given straight line of Proposition I. cannot be so entirely free from restriction, as to length, as the given straight line of Proposition XXXI.; and hence the propriety of the restrictive term *finite* in the former. I should not have said so much about a mere word, had it not been for the hypercriticism of others. You must therefore regard these remarks, not as a comment upon *Euclid,* but as a comment upon his commentators.

The other matter I should wish you to notice, in connection with this first proposition, is, that what is called "the point C, in which the circles cut," is in fact either of *two* points, one on each side of A B, so that a second equilateral triangle may be described, on the opposite side of the given line; and it is this latter position which the equilateral triangle, introduced into the construction of Proposition IX., is to take. I shall only further notice, that it would have been somewhat more explicit, if Euclid had referred to the point C as where the *circumferences* cut, rather than as where the *circles* cut; though it is quite true that the circles themselves interpenetrate there; but the distinction, very properly made by Euclid in his definitions, between circle and circumference, is in danger of being overlooked by a beginner, in consequence of Euclid's mode of expression, in reference to intersecting circumferences.

Proposition IV. is the first of Euclid's *theorems;* and, being the first, and involving no construction, its proof depends solely on the axioms. The demonstration hinges upon what has been called the method of *superposition;* that is, the imagining one figure to be placed upon another, with a view to their perfect adaptation and coincidence, and thence to the inference of their complete *equality* (Axiom 8). If you wish to try the experiment, whether or not you have any taste or aptitude for geometrical reasoning, you may, if you please, *commence* with this theorem; and study the three preceding problems afterwards. It is a very beautiful specimen of Euclid's mode of argumentation; and is quite within range of the powers of the merest beginner. But before you address yourself to it, it may be as well to reflect that the relative *positions* of two things can have nothing to do with their relative *magnitudes;* that the two triangles, affirmed under certain conditions to be *equal,* and placed side by side before you on the paper, must remain equal, however their relative positions be altered; whether one be turned upside down, or be made to overlap the other, can make no difference as to the equality or inequality of the two in *magnitude.* You will thus see that, for the purpose of instituting an inquiry as to the equality of the triangles, it is quite allowable to imagine one to be placed upon, or to be applied to the other, with the view of ascertaining whether, by a suitable adjustment, a complete adaptation may be brought about. In this manner Euclid directs you to apply the triangle A B C to the triangle D E F in a certain way—namely, so that the point A may be on D, and the straight line A B upon D E. He then affirms that B must coincide with E; and as he never affirms anything without immediately answering the inquiry *why?* he adds, *because* A B is *equal* to D E. The adjustment is thus brought about as far as the sides A B, D E are concerned; he then asserts that, this partial adjustment remaining undisturbed, A C must fall upon D F, *because* the angle or opening A is equal to the angle or opening D. If A C fell *beyond* D F, the angle A would be *greater* than the angle D; and if A C fell *short of* D F, the angle A would be *less* than the angle D; Euclid's conclusion, therefore, is irresistible. As A C then necessarily falls upon D F, the point C must as necessarily fall upon, or coincide with the point F, *because* A C is *equal* to D F. And thus having proved, first, that B coincides with E, and then that C coincides with F, he infers, in virtue of the 10th Axiom, that the base B C must coincide with the base E F. Hence the adaptation is complete; there is perfect coincidence, and therefore perfect equality in every respect.

Proposition V. is always found to be more or less perplexing to a learner; and it is certainly one of the most, if not *the* most knotty of the propositions in the first book. I would recommend a beginner, after completing the construction as directed, to erase the base B C of the original triangle, in order that nothing may divert his attention from the two triangles A F C, A G B. The line thus expunged may be restored after these triangles have been proved to be in all respects equal: they are nothing more than the two triangles already considered in Proposition IV. in a different position, one triangle partially overlapping the other. Young students are sometimes deterred from prosecuting the study of Euclid by the length and difficulty of this proposition. They should be apprised that the propositions are not arranged in the order of their difficulty; that none more troublesome than this fifth will ever after be met with, and that the last theorem in the book is quite as easy as the first. A great point will be gained, if you master this fifth proposition; for you may then conclude with confidence that you will find yourself fully adequate to all that follows: but you must not come to this conclusion till, closing the book, you find yourself able to demonstrate the theorem step by step without a reference to it. This mode of testing your progress must be resorted to all along. It is not enough that you read and understand Euclid's demonstrations—you must acquire the ability of furnishing these demonstrations yourself; you may vary the language, but you must preserve the rigour of the argument, affirming nothing without a reason; which reason, mind, must be *the* reason.

I do not clearly see why the fifth proposition should be called *Pons assinorum*, or *the asses' bridge*. They say it is because "asses" stick at it; but I believe it was the *twentieth* proposition that was so designated by some of the ancients; for Proclus informs us, in his "Commentary on Euclid," that the Epicureans derided the twentieth proposition as being manifest "even to asses;" for if a bundle of hay were placed at one extremity of the base of a triangle, and an ass at the other, the animal would not be such an ass as to take the crooked path to the hay instead of the straight one; as he would know the direct course to be the shorter: *this* was therefore called the *asses' bridge.*

The sixth proposition you will find very easy after the fifth: it is what is called the *converse* of the first part of the former proposition. A theorem is said to be the converse of another, when the hypothesis and the consequence in that other change places. The hypothesis in Proposition V. is, that two *sides* of the triangle are equal; the inference or consequence is, that the two *angles* opposite to them are equal. The hypothesis in Proposition VI. is, that two *angles* of a triangle are equal; and the consequence is, that the two *sides* opposite to them are equal: the one proposition is therefore the converse of the other. In general, Euclid demonstrates the converse of a previous theorem *indirectly,* or by what is called the *reductio ad absurdum* method; that is, he commences with a denial of the truth stated; and, reasoning from the contradictory statement, as if it were true, shows that an absurdity, or impossibility is the unavoidable consequence; thus proving that the thing contradicted cannot be otherwise than true. Throughout the whole of this book, the last proposition is the only converse theorem that is not demonstrated in this indirect manner. It is not every theorem that is true both directly and conversely. You should take note of those that Euclid proves to be *convertible,* and endeavour to discover for yourself which of his propositions hold conversely, though only proved directly. For example, Proposition XXXIV. proves that if the opposite sides of a quadrilateral are *parallel,* they are also *equal.* It is also true conversely, that if the opposite sides are *equal,* they are also *parallel,* as you may prove for yourself, after the direct proposition has been established.

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PRACTICAL ESSAYS ON EDUCATION.

DUTIES OF THE TEACHER.—(*Concluded.*)

Two objects, at least, are gained by the separation of the pupils into classes; first—their better chance of improvement, collectively; and, secondly, the emulation created by the gain or loss of position in the class.

In determining the class to which any individual pupil should either be originally posted or subsequently removed, the natural criterion obviously is, neither his age nor the length of time he has been under tuition, but his actual proficiency. When a new pupil, accordingly, is introduced into your school, you should make trial of his qualifications, in order to determine in which class he should be placed. This is not always an easy or agreeable matter to decide, and the decision often gives umbrage to the parent.

"My boy," I am not unfrequently told, "was in the upper class at his last school: he has gone quite through the Tutor," &c.

Notwithstanding this large profession, the alleged proficient is frequently found quite incapable of reading such a book as the History of England; of understanding more than the simplest questions in geography and grammar; or of performing more than the most elementary operations of arithmetic. He is accordingly of course placed in the class where he is most likely to receive improvement, without regard to his former pretensions. His continuation in this class, however, depends entirely upon his subsequent progress. If it be found that he so far outstrips all his class companions as to stand continually at the top, without much exertion on his part, it is high time that he should be promoted to a superior one, where he may find his level, and have all his energies called into operation. If, on the other hand, it turn out that he is constantly as the bottom of the class, in a hopeless state of inability to compete with his present class-fellows, it would prove beneficial to remove him to a still lower class, where he could better maintain his ground. It requires, however, more than usual judgment to do this without offending the boy's *amour propre.*

In some schools, where various branches are taught, there is a distinct classification for each department of study. Thus, there is one set of classes for reading, another for arithmetic, another for geography, &c. It is, in many respects, a good plan, for it generally happens that the same child will make very different progress in different branches. With some, geography is the favourite study; with others, arithmetic; with others, grammar. A child may therefore be in the first class in arithmetic, and in the third in grammar; or he may be in the first class in geography, and in number four in reading.

The usual plan of action in classes is, that the individuals who compose each class take precedence amongst each other according to the manner in which they perform their various tasks. When any scholar has committed a blunder, the one immediately next him in the class is at liberty forthwith to correct it, being liable, at the same time, to be put down himself, if in so doing he fall into a mistake. When the next boy does not correct the error, then the next to him has the opportunity granted; and if he be successful in giving a correct answer, he is put over the rest.

To avoid confusion in the changing of places in class, the boy in taking his place should pass along the front of the line; when a child is put down, on the contrary, he should pass along the rear.

By some theoretical persons and moral refiners, emulation, the fundamental principle of the arrangement into classes, has been condemned as one which has the very worst tendency, because it leads, as they assert, to envy and other unchristian passions, and ought, therefore, to be banished from every school. These opponents contend that the student should require no other stimulus than the pure and unmingled love of knowledge and of duty; and that emulation is a base alloy, which at the same time genders envy, hatred, malice, and all uncharitableness.

For myself, I very much incline to the opinion that "a cook might as well resolve to make bread without fermentation, as a pedagogue to carry on school without emulation: it must be a sad doughy lump without this vivifying principle."

"I am firmly of belief," says Mr. Wood, of Edinburgh, "that it is a noble and animating incentive, that of the desire implanted in our bosom, of rising superior to our fellows. How many slumbering faculties has not this vital principle roused into exertion! To how many splendid discoveries and inventions—to how many deeds of virtue and exploits of heroism—to how much individual happiness and social improvement, has it not given birth! In place of being a base and sordid passion, is it not one which burns brightest in the noblest and most generous souls?"

Fanciful philosophers would, it sometimes appears, deprive us of all motives; for there is none to which captious ingenuity cannot object. I really think, that, without emulation, instruction would often be a tedious and fruitless labour. It is this which warms the passions on the side of all that is excellent, and often counterbalances the weight of temptation to idleness and other "drawbacks." The boy who stands at the head of his class ranks, in the microcosm of a school, as a sort of hero. He spares no pains to maintain his honourable post, and his competitors are no less assiduous to supplant him by generous exertions. No severity, no painful confinements, no menaces, are necessary. Emulation effects in the best manner the most valuable purposes.

Cowper, who in his *Tirocinium*, inveighs so strongly against emulation, has a remarkable passage in his *Task*, in which he evidently laments its decay.

> "Discipline at length,
> O'erlooked and unemployed, fell sick and died,
> Then study languished, *Emulation slept*,
> And virtue fled."

With regard to the feelings of envy, hatred, &c., which are said to follow in the train of emulation, I am far from denying that this principle, like every other, is liable to abuse, and may, under improper management, produce the effects ascribed to it; but I can, from large experience, confidently pronounce that these are not its necessary fruits.

Before I conclude this section of my subject, I would anxiously impress upon all engaged in the education of youth, the deep importance of one species of emulation, namely, the eager desire to rival and surpass our former selves, so well portrayed by Dryden in the following lines :—

> " A noble emulation heats your breast,
> And your own fame now robs you of your rest;
> Good actions still must be maintained with good,
> As bodies nourished with resembling food."

But, above all, it should be a leading principle in education, to mark every the slightest improvement on the part of those from whom little had been expected with no less approbation than the more rapid studies of those on whom nature or previous education had conferred greater advantages.

There is one more subject on which I may be permitted here to say a few words. Habitual lateness or absence from school, even when occasioned by the parents of the child, should not be allowed, as it is then utterly impossible that the scholar can properly advance in his studies. By losing his position in his class, from such causes, he is apt to lose also a cheerful state of mind. Thus discouraged and mentally oppressed, at length the mere name of school suffuses a gloom over his countenance, and painful feelings associate themselves with the thought of every school duty. It is unnecessary to add, that, under these circumstances, he will not adequately improve.

It is important, however, to observe, that there are few parents who are sufficiently considerate to make due allowance in respect to the consequences arising from the lateness or absence, which they themselves have occasioned—the certain result of which is, that, sooner or later, they depreciate the teacher's professional character. Rather, therefore, than expose yourself to this species of illiberality, and to the injury resulting from it, it will be better for you to dispense with the attendance of such persons' children altogether.

When children are unavoidably detained from school, they should be required to bring a note from their parents, containing nothing more than the time of the day they left home, and the parent's signature. More than this is unnecessary, because it is tiresome for the parent to write, and the teacher to read. If the child, on coming late, is unable to produce a note of this nature, the teacher should receive no oral statement, nor should he attempt to discriminate, but mechanically infer, that the lateness is attributable to the pupil's negligence. A rigid reference to this is necessary, if the teacher would secure early attendance, and preserve from fatal relaxation the discipline of his school in that respect.

A note from the parent, in case of absence, should be invariably required ; and if the pupil is unable to produce it, the teacher must, in every case, draw the same mechanical inference as in the case of lateness, and for the same reasons.

In my next paper I propose commencing a short series of essays on Physical Education.

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INORGANIC CHEMISTRY.

XVI. SODIUM.

Manufacture of Glass.

Silicates of Soda.—Both soda and potash form compounds with silicic acid by fusion, which are silicates, but of uncertain composition. If 4 parts ot the alkali are used to 1 of the silica, the glass is soluble ; but whatever may be the proportions used, the resulting silicate is always an uncrystalline, homogeneous, transparent mass. The "*soluble glass*" formed by fusing together 8 parts of carbonate of soda (or 10 of carbonate of potash) with 15 parts of pure sand, and 1 of charcoal, is insoluble in cold, but dissolves in 4 or 5 parts of hot water, forming a sort of varnish, which may be applied to wood or manufactured stuffs, which are to a good degree protected by it from the action of fire.

Glass is a variable compound of the silicates of potash, soda, lime, and alumina, with oxides of lead and iron, fused together by a very high and long-continued heat, in proportions suited to the object for which the glass is to be used. This is not the place to describe the varied and interesting manipulations by which the fused material is blown, cast, moulded, or pressed into the countless forms of utility and ornament which the wants of society demand. A visit to a large glass-house is always full of instruction and pleasure.

Window-glass is a silicate of soda and lime, which requires an intense heat for its fusion, and forms a very hard and brilliant glass. *Plate-glass,* such as is used for mirrors, crown glass employed for glazing, and the beautiful *Bohemian glass,* are all silicates of potash and lime.

Crystal-glass is formed by fusing together 120 parts of fine sand, 40 of purified potash, 36 of litharge or minium (oxide of lead), and 12 of nitre. This forms a very fusible glass, easily worked, and so soft as to be cut and polished with comparative ease.

Green-bottle Glass is usually a silicate of alumina, with oxides of iron and magnesia, and potash or soda. It is formed of the cheapest refuse of the soap-boiler's waste, and lime which has been used to make caustic potash or soda.

All glass must be carefully annealed after it is made, by slow cooling, or it will break in pieces with the least scratch or jar. Slow cooling of heated glass for many hours, or even days, for heavy articles renders the mass homogeneous and less brittle.

XVII. AMMONIUM.

Equivalent, 18·06. *Symbol,* NH_4 (*hypothetical.*)

Ammonia, (NH_4.)—This compound of hydrogen and nitrogen has never been isolated, though we have reason to believe in its existence. When a solution of ammonia, or of sal-ammoniac, is electrolised, nitrogen escapes at the + side and hydrogen at the — side; but if the latter pole is made by using a portion of mercury, no hydrogen is evolved, but the mercury swells up, loses its fluidity, becomes like soft butter, and gradually attains many times its original bulk, having the lustre and general character of an *amalgam.* A more simple mode of forming this amalgam, consists in making a little potassium or sodium combine, by heat, with about 100 times its weight of metallic mercury. This alloy, when placed in a strong solution of sal-ammoniac, begins at once to increase in volume by the formation of the ammoniacal amalgam, until it has attained very many times its original bulk, and has a pasty, butyraceous consistence.

When the alloy of potassium is placed in hydrochloric acid, the alkaline metal decomposes the acid, forming chloride of potassium and evolving hydrogen. If we substitute for the acid (chloride of hydrogen) a solution of chloride of zinc, ZnCl, a like decomposition ensues; but the zinc, instead of being set free like the hydrogen, combines with mercury to form an amalgam. The present reaction is precisely similar; chloride of ammonium, NH_4Cl, being substituted for the chloride of zinc; the ammonium which is liberated, combines with the mercury and forms the light pasty amalgam. It crystallises in cubes at 32°, whereas pure mercury is fluid even at a temperature of —39° F. It is evident that it has combined with something which has given it new properties. This is supposed to be the metallic radical *ammonium.* The spongy mass, as soon as the electric action ceases, rapidly suffers decomposition. Ammonia and hydrogen are set free in the proportion of 1 to 2, and the mercury regains its original state unaltered. Berzelius and other able chemists explain this reaction, on the ground that the ammonia, by gaining an additional equivalent of hydrogen, assumes the peculiar character of a metal, and unites with mercury, forming an amalgam. This hypothetical metal can replace potassium and sodium perfectly in combination, and is therefore isomorphous with them. All the salts of ammonia are, on this view, derived from this radical, and its union with the second class gives us a series of bodies analogous to the chlorides, bromides, &c., of the other electro-positive bases.

Salts of Ammonium.

Chloride of Ammonium; Sal Ammoniac, NH_4Cl.—This salt occurs in nature, sometimes quite pure, as at Deception Island, and in volcanic districts generally. It was originally prepared in Egypt, by sublimation from the soot of the burnt camel's-dung. It is also obtained largely from the ammoniacal waters of the gas-works. It is purified by evaporating the crude solutions to dryness, after treating them with a slight excess of hydrochloric acid to neutralise the free ammonia, and subliming the dry mass in iron vessels.

It has a sharp saline taste, corrodes metals powerfully, is soluble in three parts of cold water, and crystallizes from its solution in octahedrons. The sublimed salt has a fibrous texture, and is very tough and difficult to pulverise.

The formation of this compound is easily shown by using an apparatus already figured with hydrochloric acid in one flask, and strong ammonia water in the other; the commingling of the dry gases, driven over by heat to the central bottle, fills it with a white cloud of sal-ammoniac, $ClH+NH_3=ClNH_4$.

Sulphuret of Ammonium and Hydrogen, (hydro-sulphuret of ammonia, NH_4S+HS.) —This very useful compound is formed by passing a long-continued slow current of sulphureted hydrogen from the gas-bottle (*a*) through the bottles *d, e, f, g,* filled with strong water of ammonia. This arrangement is a simple form of Woulfe's bottles. A single bottle of ammonia (as *d*) is sufficient for all common purposes. It should be kept cold. The ammonia absorbs an enormous quantity of the gas, and the resulting sulphuret, which has the strong odour of the gas, is colourless at first, but gradually assumes a yellow colour. It is an invaluable re-agent as a precipitant of the metals, and is also used in medicine.

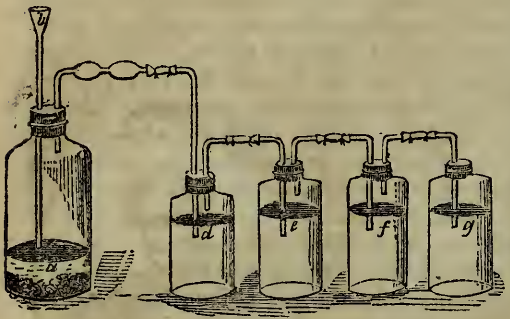

Fig. 8.

There are several simple sulphurets of ammonium; but they are of no particular interest.

Sulphate of Ammonia, or Sulphate of Oxide of Ammonium, NH_4O,SO_3+HO.—This salt, which is a powerful fertiliser, is procured in the large way by neutralising the ammoniacal liquor of the gas-works by sulphuric acid; or it may be easily obtained pure by neutralising dilute sulphuric acid with carbonate of ammonia.

Carbonates of Ammonia.—There are several of these salts. The common white *sal-volatile* of the shops, with a pungent smell and alkaline reaction, is nearly a sesquicarbonate ($2NH_4O,3CO_2$.) Exposed to the air, this salt becomes a white inodorous powder, which is a bicarbonate. The sesquicarbonate is a very valuable salt to the chemist, and forms the basis of the smelling-bottles so much in use. The dry white powder formed by the contact of dry carbonic acid and ammonia, in an apparatus like that before used, is a neutral anhydrous carbonate (NH_3, CO_2,) very pungent, volatile, and dissolving readily in water.

Nitrate of Ammonia, or Nitrate of Oxide of Ammonium (NH_4O, NO_5.)—This salt has already been noticed under the description of nitrous oxide. Its crystals resemble nitre, deliquesce in moist air, and dissolve in 2 parts of cold water, the solution sinking the thermometer to zero. It deflagrates on burning coals like nitre.

All the ammoniacal salts are volatilised by a high temperature, yield the ammoniacal odour by trituration with caustic potassa or lime, only boiling with solutions of potash. They are all soluble, and give a sparingly soluble, yellow, crystalline precipitate with chloride of platinum.

XVIII. LITHIUM.

Equivalent, 6·43. *Symbol,* L.

This very rare metal is a constituent of several minerals, as spodumene, petalite, lithia-mica, &c., from whose decomposition by a particular process, hydrate of lithia is obtained, the electrolysis of which afforded Davy a white oxidisable metal analogous to sodium. Its atomic number is far below that of any other metal, and only carbon and hydrogen are lower in the scale of equivalents; this gives its oxide a very high power of saturating acids.

The oxide (LO) is an alkali, but much less soluble than potash and soda. Its sulphate is a beautiful salt, and gives a rosy flame to alcohol. The lithia compounds all give this tint to the outer flame of the blowpipe. Its name is from *lithos* (λιθος), a stone, in allusion to the natural origin of this alkali.

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On the first of September partride-shooting commences, and then the eager sportsman, who has long watched where the birds alight and feed, with impatient step hastens to gain the stubbles, with dogs and gun. At length he reaches the ground, he "pricks" the coveys, and his pointers take their stand.

"How beautiful they look! with outstretched tails,
With heads immovable and eyes fast fix'd,
One fore-leg raised and bent, the other firm,
Advancing forward, presses on the ground!
onvolv'd and flutt'ring, on the blood-stain'd earth
The partridge lies:—thus one by one they fall,
Save what with happier fate escape untouch'd,
And o'er the open fields with rapid speed
To the close shelt'ring covert wing their way."

The marker has noticed the game. He knows the spot where they alighted, and already a pointer stands transfixed. Again—

"The gun fast-thundering"

brings the birds down, and covey after covey are thinned of its best birds. Fresh covers are beaten, and

"See how the well-taught pointer leads the way;
The scent grows warm—he stops—he springs the prey;
The fluttering coveys from the stubble rise,
And on swift wing divide the sounding skies."

Now the sportsman has bagged a goodly lot of game; and as the noontide heat, together with the sport, has made him warm, he hastens to yonder farm to taste the home-brewed ale, and exhibit his spoil.

The floral beauties of the gardens and fields are not very numerous this month, for the year is fast declining, and

"With hasty stride sage Autumn treads the plain."

Garden Flowers.—Here is the common Michaelmas daisy (*Aster Tradescantia*), and the Alpine species (*A. Alpinus*), emblematical of after-thought, with their sober flowers, which are just beginning to unfold themselves, now that other flowers are becoming scarce. There is also the Oriental arbutus (*Arbutus Andrachne*), with its beautiful foliage towering on high; and commingled we may notice, in the various parterres and clustering hillocks, many a fair and simple flower; for example—the harvest bells (*Campanula rotundifolia*); the China-aster (*Callistephus*), of various hues and kinds; the amarella (*Gentiana amarella*), the large-flowered dwarf gentian (*G. acaulis*), and the yellow gentian (*G. lutea*); the golden rod (*Solidago Virgaurea*); the Italian pimpernel (*Anagallis Monelli*); the musk rose (*Rosa moschata*); the autumnal hyacinth (*Scilla autumnalis*); the devil's bit scabious (*Scabiosa succisa*); the tiger flower (*Tigrida pavonia*); the southernwood (*Artemisia abrotanum*), and fuchsias (*Fuchsia gracilis*, &c.) of various kinds.

Wild Flowers. — Our ramble has brought us to the waste spot where the field flowers grow in profusion.

"Beautiful objects of the wild bee's love!
The wild bird joys your opening bloom to see,
And in your native woods and wilds to be.
All hearts, to Nature true, ye strongly move;
Ye are so passing fair—so passing free—
I love ye all!"

Do you observe the common meadow saffron (*Colchicum autummale*), which looks like a purple crocus, rearing its blossoms above the short grass of the meadow? You will also see it next month, towards the latter end of which its flowers will die away, and next spring the leaves and fruit appear. It is a valuable medicine, the seeds, roots, and part of the flowers being used.

Here is the common flea-bane (*Inula dysenterica*), which is often called the wild marigold. It delights in moist places, where its large, star-shaped flowers form a pleasing contrast to the green waving grass which clothes the earth with a verdant carpet.

Several kinds of grass (emblems of utility) may be collected this month, and tastefully disposed in baskets, cornucopias, and other receptacles, together with wild flowers,—those

"Beautiful children of the glen and dell—
The dingle deep—the muirland stretching wide,
And of the mossy fountain's sedgy side!"

Among the birds we may observe many taking their departure for the warmer climates, leaving only a few stragglers behind. The vagrants usually migrate by moonlight, or at any rate by night. Among them we may notice the nightingale (*Sylvia luscinia*); the fauvette (*S. hortensis*); the black-cap (*S. atricapilla*); the wood-wren (*S. sibilatrix*); the wheat-ear (*Saxicola Œnanthe*); the flusher (*Lanius collurio*); the babillard (*Carruca garrula*); the sedge-bird (*C. salicaria*); the white-throat (*C. cinerea*); the ring blackbird (*Merula torquata*); and the chimney swallow (*Hirundo rustica*). The fresh arrivals from northern parts comprise the Jack-snipe (*Scolopax gallinula*); the snipe (*S. Gallinago*); the fieldfare (*Turdus pilaris*); and the gannet (*Sula bassana*), with many other species.

The ichthyologist and angler have little to amuse them this month, for the char (*Salmo alpunis*) spawns; and unless eels (*Anguilla communis*), which often descend the river, will afford either sport or instruction, there is nothing to entice either angler or naturalist abroad.

When the day is bright, and the sun shines with its accustomed splendour, dispensing warmth abroad,

"Even the insect swarms,
From their dark nooks and coverts issue forth,
To sport through one day of existence more."

Then we may behold the death's-head hawk-moth (*Acherontia atropos*); the bind-weed hawk-moth (*S. convolvuli*); the clouded yellow butterfly (*Colias edusa*); the twelve-spotted lady-bird (*Coccinella*, twelve-

punctata); and the sixteen-spotted lady-bird (*C.* sixteen-*punctata*). We may also find the large green locust (*Acrida viridissima*); the voracious field-cricket (*A. verrucivora*).

The quadrupeds of the month are the squirrel (*Sciurus vulgaris*); the Alpine hare (*Lepus variabilis*); the hedgehog (*Erinaceus Europæus*); water-rat (*Arvicola aquatica*); and the dormouse (*Myoxus avellanarius*).

Let us learn good from everything as we ramble through life, even though the lesson should present itself to us coloured with vice; in that case we should learn to eschew evil. In Nature's walks the glories of the Creator surround us on every side. It is he that "causeth the grass to grow for the cattle, and herb for the service of man, that he may bring forth food out of the earth.'' As we ramble through life, let us remember the words of Crabbe, that

> " It is the soul that sees; the outward eye
> Presents the object, but the mind descries;
> And thence delight, disgust, or cool indifference
> rise."

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SOUTH STAFFORDSHIRE SCHOOL PRIZES.

The difficulty attending a law rendering it compulsory on parents to send their children to school appears, in some measure, to have been solved by the "South Staffordshire Iron and Coalmasters' Scheme" for distributing small prizes to those boys who had been at least two years at school, and shown themselves capable of passing an easy examination.

In the new blue book of public education for 1852, one of the most interesting of the reports then published is the special one by Mr. Norris on the above subject. It appears that, in order to check the tendency of the parents in that district to take away their children from school at an early period, a sum of money was easily collected, and offered in small prizes to the most successful of the competitors, agreeably to the conditions just mentioned. Out of 102 competitors, 86 were finally selected as worthy of recognition of one kind or other. The appearance of a plate, containing 130 sovereigns, "seemed to create no little sensation among the boys"—a sensation which was agreeably intensified when "ten received £4. each, and thirty £3. each."

According to Mr. Norris, "Every one present appeared to think that the first year's trial had been a most auspicious one. The manner of the boys throughout, and especially their conduct under examination, their prompt obedience to regulations, the serious way in which each addressed himself to his task, the perfect order and silence among a hundred boys during three hours of examination, and, above all, the integrity with which they severally did their work, seemed to give fair promise that the iron and coal masters' prize-men will be distinguished in after-life for habits of self-control and thoughtfulness."

There is no question but that the lures of reward are more influential on youthful minds than the fears of coercion; and when we take a review of what the lower orders of South Staffordshire have been, and unfortunately still are, we cannot withhold our expressions of delight at the above satisfactory results.

In speaking of the peculiar locality under review, generally known as "The Black Country,'' where these laudable endeavours to educate the humbler masses are being carried into operation, a modern tourist gives the following characteristic sketch:—

"The majority of the natives of this Tartarian region are in full keeping with the scenery—savages without the grace of savages, coarsely clad in filthy garments, with no change on week-days and Sundays; they converse in a language belarded with fearful and disgusting oaths, which can scarcely be recognised as the same as that of civilized England." . . . "It would be a useful lesson for any one who is particularly well satisfied with the moral, educational, and religious state of his countrymen, to make a little journey through this 'Black Country.' He will find that the amiable enthusiasts who meet every day at Exeter Hall to consider the best means of converting tribes in Africa, India, and the islands of the Pacific, need not go so far to find human beings more barbarous, and yet more easily reclaimed."

Thus in the 19th century of the Christian era, and the 4th of the Reformation of this country, we have to deplore the lamentable ignorance of the masses; and we naturally wonder how it is that so many myriads are allowed to remain in such a state of brutal ignorance and social depravity. Unhappily in the face of such savagery as we have just described, so evidently the result of defective education, and which the gentlemen of South Staffordshire are endeavouring to alleviate, two opposite and extreme parties—the pro-church and the anti-church ones—combine to oppose the extension of education, except in accordance with their own sectarian views; although that education, at least teaches decency, if it does not effectually civilize and spiritualize a community.

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EDUCATIONAL MOVEMENTS OF THE ROMAN CATHOLICS.

> "The good old man, too eager in dispute,
> Flew high; and, as his Christian fury rose,
> Damn'd all for heretics who durst oppose."
> DRYDEN'S "RELIGIO LAICI."

THE increasing diffusion of education among the humbler classes of society, especially in Ireland, has at length imparted an impulse even to the torpidity and long opposition of the Romish hierarchy. The tide has set in; and no human power can long resist its advances. It was in vain that Canute commanded the waves of the sea to stand still; and it is equally impossible that any body of men, however potent their authority, can longer oppose the rolling avalanche of educational progress, or effectually subdue its liberalizing influences.

At a late meeting of the Roman Catholics of London, which took place at their schoolroom in Somers Town, these sentiments strongly manifested themselves. It appears that the boys' schools have been gradually falling to decay, and the youngsters, in large numbers, have attended the "Ragged" and other schools of a Protestant character, which, as the Roman Catholics aver, have a proselytizing tendency. The object of this meeting was therefore to raise funds for the purpose of counteracting these alleged evils.

After the chairman (the Rev. J. Kyne, of Rosomond Street Chapel) had appealed to the meeting for pecuniary support—especially to "the labouring Irish"—a Mr. Lynch (from Ireland) came forth as the great gun of the occasion, and demonstrated the necessity, even among the poorer Romanists, of secular education; though we regret to say that the address which accompanied his proposed "resolution" betrayed more bigotry than philanthropy. The purport of the resolution was, that the meeting was desirous of seeing a Catholic education extended among the poor. He believed the extension of such education to be important, especially on account of the danger to which they were exposed, from the evil influences of those who offered them education at the sacrifice of faith, and deemed it "incumbent to use every means to establish such a system of religious and secular instruction as to prevent the poor having recourse to Protestant schools."

The proposer of the resolution then proceeded to say, that the Catholics prized education "because it raised a barrier to one of the most dangerous attacks ever made upon their faith. A new weapon from the armoury of hell [Protestant education!] had been brought to bear on them, and it was telling with powerful effect upon the children of the poor! He alluded to the present Protestant proselytizing system of education—from the Godless colleges in Ireland down to the Ragged Schools in England. And this was a movement more fraught with danger to the Catholic interests than anything they had ever suffered from. With the Godless colleges he had nothing to do. He believed the days of those institutions were numbered. Rome had spoken against them, and against the voice of Rome he did not believe they could stand in such a country as Ireland. But even if they were to stand, they only affected the rich, which was a small minority. But the ragged schools affected the poor,—that great mass of people on which the Catholic religion of this country mainly depended. Upon the authority of their present supporters, they were turned to proselytizing purposes. Was this state of things to continue? Were they to allow the Roman Catholic religion in this country to die out with the present generation? They boasted of all the converts they were making; but they said nothing of those who were going from amongst them. They counted their gains; but they took no heed of their losses. They could not, it was true, compete with Protestants in the cause of education, but they could do something."

Thus popular education, which has heretofore been deprecated by the Romish priest as "dangerous to the faith," and as a great *evil*, is at length discovered to be a social *good*. With Milton's hero, the priest now exclaims—"Evil, be thou my Good!"

THE CENTESIMAL SYSTEM OF MONEY.

BY DR. P. A. NUTTALL.

"Who custom makes his general rule,
Lives like an ape, and dies a fool."

The advantages of a decimal or rather centesimal system of money, appear now to be generally admitted. A few antiquated schoolmasters, or senile accountants, may possibly for a short time oppose its introduction; but the great masses of our scholastic juveniles, and myriads of plodding tradesmen, will have reason to bless the day that sees its national adoption. With our daily extending trade and commerce, the perplexity of our monetary calculations, and their incongruity with the currency and coinage of other countries where the decimary principle is established, demand our immediate consideration. The sovereign, or pound sterling, is so complicated and irregular in its various divisions and subdivisions, as not only to puzzle foreigners, but to require a long and tedious course of education to acquire a facility in money calculations; and few there are who have not reason to remember the early difficulties they experienced in learning their first rudiments. Although the ordinary process may appear very easy to bankers, merchants, and clerks, who have devoted their whole lives to the practice of figures, still money calculations are usually a task of great labour to the thousands of retail traders and business men who constitute the vast majority of the community; and therefore any plan which introduces facility of calculation and more certain accuracy in our every-day accounts, must be acceptable to the nation at large.

The principal difficulty, in the adoption of a new system of calculation, is in readily applying it to the existing coinage, without material alteration in the established nomenclature. But the parliamentary committee, in their recent report on the decimal coinage, have raised difficulties where none ought to exist. In suggesting that the pound sterling should form the integer of all monetary accounts, they are right in proposing that it should be divided into a thousand parts, by making it worth 1000 farthings, instead of 960, as at present. According to this plan the decimation will become complete by the pound being divided into ten florins, or *decimes;* the florins into ten *cents,* or ten-farthing pieces; and the cents into ten *mils,* or farthings. The shillings would then be worth fifty farthings, and the sixpences valued at twenty-five. To carry this proposal into operation, the half-crowns, fourpenny pieces, and threepenny ones, would have to be withdrawn from circulation, and a new coinage issued, consisting of five, ten, and fifteen-farthing pieces each. Thus the monetary circulation would consist of *pounds, centimes* (or florins), *decimes* (or ten-farthing pieces), and *mils* (or single farthings).

Now, in the proposal to reduce the value of the copper coinage, there can be no impolicy or injustice, because the price of the raw metal bears no relation to that of the copper coin; while the intrinsic value of the silver coin is nearly equal to its current worth, and less fluctuating than any other metal.

But there is no necessity for the complicated divisions proposed by the Committee. The government having assented to the general principles and convenience of a decimary currency, all that we now require is a general enactment, declaring that the sovereign, or pound sterling, should form the integer, or basis, of our monetary system of account; and that the florin, divided into centesimal parts, should constitute the silver standard of unity. These two denominations would be all that is necessary for our moneys of account. Instead of having four denominations (pounds, decimes, cents, and mils), every monetary operation might be carried on with pounds and florins—the latter being divided, not into decimal but centesimal parts. Thus 4*l.* 16*s.* 6*d.* would be written 4*l.* 8·25*fl.* By this plan we steer clear of the very perplexing system of *decimes* and *mils*—the former being too small for minute divisions of money, and the latter too large for the ordinary calculations of life. We also render the issue of a new copper coinage unnecessary, at least for the present; and the complications of the ten farthing piece, which the Government committee very injudiciously propose to call a *cent* (whether silver or copper they cannot say) will be altogether superseded. Another great advantage is, that we shall assimilate our currency and its nomenclature to that of other nations. France, America, and Holland have long adopted the centesimal parts of a franc, a dollar, and a guilder respectively, and thus readily carry on their monetary operations with two denominations of money. Then why should we not establish the same simple principle, with the advantage of retaining the sovereign, or pound sterling, as a standing integer *per se,* and the farthing as the centesimal unit of the florin! Few persons, in ordinary life, know the meaning of *mil* or *millesimal,* or even of *decimal;* but almost every one, from the number of cognate words in our language, understands the meaning of *cent* or *centesimal.*

It is therefore proposed to call the new plan the "Centesimal System of Money;" the adoption of which will render any new currency unnecessary, as every existing coin can be instantly reduced to the centesimal parts of the florin,—the present farthing representing a cent. Thus the halfpenny, penny, threepenny and fourpenny pieces will retain their present value —the cent, or farthing, being added only when the amount reaches sixpence.

The following enumeration of the equivalent centesimal values of every existing coin, presents the system at one view—one-and-sixpence being included, in order to make the centesimality, in its descending process, the more complete:—

£	s.	d.		fl.
1	0	0	equiv.	10·00
0	10	0	=	5·00
0	5	0	=	2·50
0	2	6	=	1·25
0	2	0	=	1·00
0	1	6	=	·75
0	1	0	=	·50
0	0	6	=	·25
0	0	4	=	·16
0	0	3	=	·12
0	0	1	=	·4
0	0	0½	=	·2
0	0	0¼	=	·1
£2	3	2¾	=	£1 1·60*

Thus we find, that every denomination of our gold and silver coinages can be momentarily reduced to the florin, or its centesimal parts, without any knowledge of abstruse decimal operations; and this simple formula could be committed to memory in one-tenth of the time usually occupied by the common pence-table of the schools. In truth, the whole system would require nothing more than the knowledge of multiplying and dividing by *four.* Thus, if we multiply the odd pence of the shilling by four, we gain the centesimal, or cent, of the florin—adding one, of course, for each silver sixpence; and, on the contrary, if we divide the centesimal by four, we obtain the equivalent amount of pence. And it should be particularly borne in recollection that the fourth, half, and three-fourths of the florin are always expressed by ·25, ·50, and ·75, which form the fourth, half, and three-fourths of 100, agreeably to the common decimal system. The least practice, however (supposing the present coinage should remain in circulation), would soon render the system of converting one into the other a mere matter of every-day facility.

We shall now proceed to reduce the system to practical operation, from which it will be readily seen that the whole course of monetary or compound arithmetic, as taught in our schools, and practised in counting-houses, is mere tom-foolery—"a delusion and a snare" to rob the poor student of his money and his time.

ADDITION.

	£	s.	d.		£	fl.
	1	12	0	equiv.	1	6·00
	1	12	6	=	1	6·25
	1	13	0	=	1	6·50
	1	13	6	=	1	6·75
	1	14	3½	=	1	7·14
	1	14	9½	=	1	7·39
	1	14	11	=	1	7·45
	£11	15	0	=	£11	7·48
Deficiency on the odd pence						2
					£11	7·50

SUBTRACTION.

	£	s.	d.		£	fl.
From	2	16	6	equiv.	2	8·25
Subtract	1	18	9½	=	1	9·39
		17	8½	=		8·86

	£	s.	d.		£	fl.
From	11	15	0	equiv.	11	7·50
Deduct	6	17	4½	=	6	8·68
	4	17	7½	=	4	8·82
Difference on odd pence						1
					£4	8·81

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* In this addition we find one cent less, on account of the fractional values not being added to 3d. and 4d.

We shall now apply the centesimal principles to the more intricate rules of Compound Multiplication and Division, Reduction, and the Rule of Three; from which it appears evident, that their adoption, even if not promoted by government, must greatly facilitate our monetary calculations.

MULTIPLICATION.

Multiply £2 17s. 6¾d. by 17.

Now the usual school process of doing this, is to multiply by 4, and again by 4, and then add the multiplicand to the result, which process requires above a score of figures; and even the rule of Practice requires five intermediate lines of figures before arriving at the result. But if we put down the equivalents in florins, and then centesimals, the quotient is obtained in one simple line:—

£ fl.
2 8·78
17
48 9·26

DIVISION.

Divide £250 16s. 6½d. by 120.

120) 250 16 6½ (2 1 9½
240
10
20
120) 216 (1
120
96
12
120) 1158 (9
1080
78
4
120) 314 (2
240
74

Now all these figures, so bewildering to the juvenile student, are done centesimally in one line; thus—

£ fl.
12,0) 250 8·27
2 0·92 equiv. £2 1s. 10d.

REDUCTION.

The rule of "Reduction," which occupies so large a space in our Arithmetical Tutors, will be rendered useless by the adoption of the centesimal system: for if the scholar is required to reduce £25 17s. 6½d. to farthings, he has only to note down the amount in pounds and florins (£25 8·77), and the answer is complete, viz., 25,877 farthings; or 258 florins, and 77 cents, as expressed in the parenthesised figures.

RULE OF THREE.

If 10 yards of cloth cost £2 16s. 6d., what will 120 cost?

Now the usual working of this sum, as taught in our schools (viz., reducing the money to pence, multiplying by 120, dividing by 10, and finally converting the whole into pounds, shillings, and pence), will cover the surface of a boy's slate, and perhaps occupy him some days in obtaining a correct solution. Let us, however, reduce it to centesimal order, and we obtain a correct result by a kind of railway process:—

£ s. d. £ fl.
2 16 6 equiv. to 2 8·25
120
10) 339·000
£33 9·00

Thus, all the complicated money calculations of trade and commerce might be reduced to the utmost simplicity and certainty, instead of being involved in perplexity and confusion. At the same time there need not be the least alteration in the relative or existing values of our gold and silver coinage.

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NATIONAL EDUCATION IN THE UNITED STATES.

There is a striking difference between the state of public education in our own country and America. In England, we rely on the government for taking the initiative; and thus we meet with nothing but procrastination and disappointment. In America, popular education, from the commencement of her social existence, has been based upon the idea of general citizenship more than on the principles of sectarianism, or the feelings of individual philanthropy. In America, education has not been bestowed in the light of mere alms upon the poor, but has been considered a privilege which every citizen, as such, had a right to claim, and to impart it as a duty which every citizen was bound to fulfil.

The direct consequences have been, that in America the popular schools, maintained at the expense of the state, are excellent, while the institutions connected with the higher branches of education are by no means equally admirable.

In New England, the first colonists were sedulous to secure a good education for the growing generation; and as soon as the pilgrim fathers, who landed in New England in 1620, had taken the requisite steps for their security, and the promotion of material well-being, they addressed themselves to the subject of popular instruction. Boston was founded in 1630, and the most ancient entry on the records of their town bearing upon this subject is dated 1634.* The foundation was then laid for the system of gratuitous instruction, which, with certain modern modifications, exists to this day in the state of Massachusetts.

The following remarkable passage, in one of the laws of Connecticut, relative to the public schools, bearing the date of 1650, is worthy of deep attention, and, in its spirit, of imitation. "That if any individual above the age of sixteen, and naturally of sound mind, swears at or strikes his or her father or mother, he or she shall be punished with death, *except in cases where it can be fully proved that the parents have utterly neglected the education of the child.*" The leading object of the New England educational system was to make popular education a matter of local administration as regards the support and superintendence of the schools. Thus attendance at school was compulsory. The religious instruction imparted, as well as the whole organization, bore a Protestant character; but the schools were open to all religious denominations. It was an almost unheard-of thing in New England, at the early period to which we are referring, to meet with an adult of sound mind who could not read and write; and this was when such simple attainments were regarded in Europe as rare accomplishments, and popular education, as a general system, was altogether unknown.

The war of independence, like all wars, proved sadly detrimental to moral and intellectual culture. The immediate consequence of that struggle was the diversion of all minds to mere political questions; the vast progress, too, of material prosperity, and lastly and more recently the enormous influx of ignorant immigrants, have disturbed and checked educational development. But throughout this long period of war, internal commotion, manufacturing progress, commercial activity, and other vicissitudes, zeal for popular education was never entirely extinct, and rarely inactive, as the laws of the several states, at the most turbulent crises, testify.

Now that a wiser international policy has checked the influx of crime into America, the vast mass of misery which is hourly poured upon its shores is a subject calculated to awaken the anxiety of every American citizen. The myriads of immigrants who are continually arriving in their flight from destitution, are sufficient to disturb the balance of the most nicely adjusted social system. The consequence is, as we learn from the police reports of New York and other American cities, the large towns are filled with crowds of young vagrants of both sexes, who from their infancy imbibe such culture as may be obtained in the public streets, and thus become addicted to all manner of vice. As, however, the rights of citizenship are speedily acquired in the United States, these immigrants are soon absorbed and easily confounded with the native population.

From the period of General Jackson's presidency commenced a new era in the history of popular education in America. A regular and active system of state control and supervision, as regards the national schools, has been established. Means have been provided for the education of the teachers by the introduction of normal schools; better methods of instruction have been adopted; school-houses on improved plans have been built; and every branch of national education reformed and improved. "Free schools" are intended to be really free, where no fees whatever are paid. "Public schools" is the name given to all schools which are supported by the public, and which are therefore under public control. The specific term, however, for the national schools, as regards their rank as educational institutions, is "common schools." The common school is not the mere "reading, writing, and arithmetic" school of an English village.

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* For these historical notices we are chiefly indebted to Siljeström's recently published work on the "Educational Institutions of the United States."

When we feel disposed to relinquish all effort to imitate the educational activity of America, on the joint ground of different manners and different capabilities, let us remember our common origin, nor overlook the fact that English hands laid the foundation of the educational building which now towers so proudly and displays so goodly a front across the Atlantic; and when we balance capabilities, and ask how can Englishmen add an education-rate to poor's-rate, police-rate, highway-rate, and the thousand and one other rates which are now breaking our backs, let us count the costs respectively of the prison, the penitentiary, or the workhouse, and the school, and we shall find the last cheaper than any one of the other three—all three rendered more needful by its absence.

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COLLEGES AND ACADEMIES IN NEW YORK.

A REPORT, recently issued by the government of the Union, contains a variety of statistical notices relative to the colleges and academies under the superintendence of the "Regents of the University of the States." In this official paper there are 7 colleges and 160 academies particularised; though, it appears, the full number of these schools is nearer 200.

The academies mentioned in the report had received, in the course of the year, 16,331 pupils (namely, 8078 boys, and 8253 girls), who had fulfilled the condition named in the statutes ; *i.e.* who had, during four months, attended either the classical or the higher English course; and the average ages of the pupils in each academy coming under this head, varied from 13 to 19 years. The aggregate value of the buildings and sites of the 160 academies was 1,176,548 dollars; of the libraries, 69,881 dollars; and of the various apparatus, 70,018 dollars. The revenue for the year arising from school charges amounted to 227,576 dollars, consequently to little more than 10 dollars for each pupil. The total receipts during the year were 294,200 dollars. Out of this, 232,375 dollars were paid away in salaries. The total number of masters and tutors were 695, but the number in each school varied from 1 to 25. Some of the academies for girls had the greatest number of tutors.

The usual branches of instruction in the popular schools are taught in all, or almost all, the academies. Composition is taught in all, on an average, once every fortnight, elocution likewise. In 1849 Latin was taught in 153 academies; *i.e.* in all the academies for boys, and in 10 of those for girls; Greek was taught in 140 academies, that is, in all the boy academies, with the exception of 9, and in 2 female academies; Hebrew in 4; French in 134; German in 25; Italian in 11; Spanish in 11; Algebra in all; differential and integral calculus in 7; analytical geometry in 19; descriptive geometry in 6; conical sections in 12; plane geometry in 149; trigonometry in 84; logarithms in 27; astronomy in 143; physical sciences in 151; land surveying in 117; engineering in 9; anatomy in 49; botany in 108; chemistry in 141; geology in 59; hygiene in 3; mineralogy in 19; natural history in 41; physiology in 102; general history in 107; history of the United States in 86; evidences of Christianity in 20; natural theology in 23; logic in 37; theoretical philosophy in 94; moral philosophy in 81; political economy in 13; rhetoric in 95; stenography in 4; phrenology (!) in 2; drawing only in 20; vocal music only in 10; and instrumental music in 9; gymnastics only in 1.

Of the general character of the educational institutions of the United States, *Columbia College*, in New York, may be considered a fair specimen, as belonging neither to the superior nor inferior colleges of the country. According to the calendar of 1849, the administrative body of this college was composed of 24 trustees, and the staff of teachers of 1 professor of theoretical and practical philosophy, political economy rhetoric, and belles-lettres; 1 of mathematics and astronomy; 1 of natural philosophy and chemistry; 1 of the Latin and Greek languages and literatures; 1 tutor in the same branches; in Hebrew, German, French, Spanish, Italian, elocution, and jurisprudence, 1 each. The president merely superintended. The number of students was 130, divided into four classes, viz., 31 seniors, 33 juniors, 39 sophomores, and 27 freshmen. The conditions of admission into the lowest, or freshman's class, are a knowledge of Latin and Greek grammar, together with the rules of prosody, &c. The chief management of the institution is vested in the *Board of the College*, composed of the president and all the professors in the four classes named above, and to this authority appeals are to be made in all matters of discipline which cannot be decided by the president alone. *Commencements* are held every year at the end of July, when the degree of Bachelor of Arts is conferred on the students who have gone through the whole course. The degree of Master of Arts is quite honorary, and is conferred on persons considered worthy of it, but not until three years after they have received the diploma of a Bachelor of Arts.

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EDUCATIONAL AND SCHOLASTIC MATTERS.

PUPIL TEACHERS.

Among the most important creations of the Governmental Education system in England, is that of a class of pupil-teachers, on whose condition Mr. Watkins, the Yorkshire Inspector, makes some valuable remarks. At present, according to Mr. Watkins, there is considerable difficulty in his district in obtaining fit candidates for vacancies in the department of pupil-teacher, owing to the more remunerative, and, above all, the more ready and certain payment to labour in the commercial and manufacturing spheres. At fourteen years of age, the pupil-teacher can only receive £10 10s. per annum; at eighteen, only £20; so that "there is plainly no inducement in this state of things for a young man to give up the usual labour, either of the field or the factory, for that of the school;" and Mr. Watkins accordingly recommends an augmentation of pay. To the objection that the system of pupil-teachers is apt to create a large class of young people who, at the end of their apprenticeship, might be thrown upon the world in too great numbers for the extant vacancies in schools, Mr. Watkins replies by giving a statement showing that, out of 121 pupil-teachers who in his district completed their apprenticeships last year, 27 have gone into other callings than the scholastic—"the young men chiefly as clerks and book-keepers, employed in railways, merchants, and lawyers' offices; the young women in domestic occupations and dress-making; so that if this proportion obtain in other districts and future years, it may be calculated that nearly a quarter of the young people employed as apprentices in our schools will not enter the scholastic profession, nor tend to create a plethora of teachers in the country."

NATIONAL EDUCATION.

On taking a review of the general educational measures which have lately occupied public attention, we find them rather in an unsettled position. The Irish National System is lapsing into chaos; the English one requires manifold expansions and alterations. Lord John Russell withdrew his Education Bill in despair; the training and reformation of criminal children is in the hands of a mere private gentleman, Mr. Adderley; an agitation is getting up for a reform of endowed schools; and sweeping changes impend over the universities. In consequence of the fate of Lord J. Russell's Parliamentary measure, the promoters of the Manchester and Salford scheme of education have abandoned their own for the present, notwithstanding the labours of the Parliamentary committee and the huge mass of evidence accumulated upon it.

Though the management of the educational business of the country appears to have devolved on Lord J. Russell, we believe him scarcely adequate to the onerous duty. In truth, it requires the active agency of a few literary and scholastic minds to bring these educational matters to a focus, and not the mere impulsive but abortive attempts of a minister of state, overwhelmed with the general business of the nation. Let not England, therefore, wait for the Government or Parliament to take the initiative in any educational movement, seeing that all which has been done in America, all the hard substantial work, has been done by the people themselves, whom the State has followed. England can raise statues to dead statesmen, and collect presents for living pets by penny subscriptions; when will they build a school or an observatory by such simple means as the Americans have done at Cincinnati? The American Cambridge has risen to its present position from the small beginning of a few presented books, a very small collection of curiosities, and a few dollars; and Yale College owes its existence to a few clergymen, who contributed a small number of books as a foundation for the college which now stands in such high repute.

CLASSICAL LITERATURE AND THE LONDON UNIVERSITY.

It is a remarkable fact that at the late matriculations at the London University College no student went up for honours in the classics; and that the greatest number by far was for those in mathematics, natural philosophy, and chemistry. Of the thirty students who succeeded in their examination for honours, there were 12 in mathematics and natural history; 2 in zoology; 2 in botany; and 14 in chemistry. At the annual distribution of prizes among the pupils of University College School, the chairman, Mr. Layard, expressed his great satisfaction at the gratifying state of the institution. After the many difficulties which its founders had to contend with, it must be highly gratifying to them to see it placed in the high position it then occupied. After referring to the fact that some of the highest names in the country had assisted in the foundation of University College, including, amongst others, Lord Brougham, and his friend beside him, Mr. Grote, and that some of the students of the school had maintained its reputation in the old universities of the kingdom, he took occasion to lament that the department of the fine arts had been hitherto so much neglected in the early education of young persons in this country. He hoped that this would soon be remedied, because the study of the fine arts brought not only pleasure to the mind, but tended to refine and elevate it.

THE VIA APPIA OF ROME.

The classical student will feel interested in learning the progress of the excavations which have been already made in the celebrated Via Appia of Roman history, and which have extended nearly eleven miles. The *Giornale di Roma* informs us that the present Pope commenced the excavations in December, 1850, from the well-known sepulchre of Cecilia Metella, situated at about three miles and a half from the ancient Porta Capena, and has, in the course of three years, extended them to the site where the ancient Boville stood, being a length of eight Roman miles. About twenty monuments have been restored to their former state. The portion of the Via Appia now laid bare is not the Roman one, but that constructed in the middle ages over the former; to raise the level of which all the fragments of the adjacent monuments had been used; so that precious historical inscriptions must still lie concealed below the modern level, as experience has proved whenever it has been found necessary to sink a hole. Besides a large number of valuable inscriptions, about twenty statues, all with the toga, have been dug up; among them, antiquaries recognize Seneca, and other great men.

LYTHAM SCHOOLS.

The endowed schools are being rebuilt at the expense of the endowment connected with St. Cuthbert's, the parish church. The design is by Mr. E. T. Owen, of Leicester, architect, and consists of boys' and girls' schools, and teacher's residence. These parts will be so arranged as to form three sides of a square, the centre surmounted by a bell-tower.

LEGAL EDUCATION.

The Inns of Court have agreed on and published a programme of new arrangements for the encouragement of legal education, and the step, though but a slight one, is in advance, and heralds more sweeping measures, which may tend to profoundly modify a system which is discreditable to the age. The new arrangements tend merely to encourage, not to compel, the acquisition of legal accomplishments on the part of nascent barristers. Certain courses of study are marked out, and certain examinations announced, the successful competitors at which will be entitled to certain bursaries, and a degree of precedence when they emerge into full-grown barristerhood.

BORDESLEY SCHOOLS.

The foundation-stone of the new schools in connection with Trinity Chapel, Bordesley, was recently laid by the Vicar of Aston. The building is intended to accommodate 400 children. It will comprise a boys' and girls' school, each 54 feet by 24 feet, and four class-rooms, each 16 feet by 12 feet. The elevation is of ecclesiastical character, and consists of a centre, 45 feet high by 27 feet broad, pierced with a square-headed window of ten lights, and terminating in a bell-turret, finished with a cross. The main edifice will be relieved by wings, containing the doorways of the respective schools. The design is intended to be carried out in red brick, with stone dressings.

ROYAL GEOGRAPHICAL SOCIETY.

This institution, so important in promoting the cause of education and of ethnical knowledge, has now formed a very large collection of books and charts; and the labours of its members and correspondents have been of much service to a science which bears so direct a relation to the progress of commercial enterprise. Mr. Hume recently brought before the House of Commons the special claims of this Society to assistance from the National Treasury, or at least to suitable apartments to be provided by the public; in return for which it was prepared to grant the latter "ready access to the maps and other means of important and valuable geographical information of which it is possessed,"—a very valuable boon. The Society has always displayed a readiness to bring its resources to bear upon the living interests, in a way to which most of our learned societies are strangers.

SCHOOLMASTER'S MUTUAL ASSURANCE SOCIETY.

According to the fourth annual report of this society, it appears that the number of policies, granted and made effective from April 1852 to April 1853, was 84 assurances upon life, to the amount of £6,675; 36 endowment annuities, £2,030; and 40 for sick provision and annuities in old age. Total, 160 new assurances, producing an annual income of £393 9s. The total number of assurances in force was 465, upon which the prospective annual income is £1,190 19s.

THE EDITOR AND HIS CORRESPONDENTS.

One of the many objects of the Family Tutor being to evoke the literary aid of the scholastic profession, and at the same time to present an arena where aspiring adolescence may shiver a friendly lance, or first learn "to plume its wings," we take this opportunity of saying that we are extremely desirous of extending the range of our correspondence, and of freely receiving the various opinions and valuable ideas of our numerous friends on the educational and scholastic matters of their respective localities; so that we may thus be enabled to collect, in our literary bouquet, the florescence of many minds—"E floribus unum." At the same time we beg respectfully to inform our correspondents that all communications for the Editor should be addressed to the firm of "Messrs. W. S. Orr & Co., Amen Corner, Paternoster Row:" where the Family Tutor will henceforth be exclusively published.

"British Plants and Structural Botany."—A second sheet of this new work, extensively illustrated, will be issued with the next number of the Family Tutor.

Chinese Writing.—The first invention of Chinese Writing is involved in obscurity; but its origin has been attributed to the enterprising genius of Hoangti, one of the ancient sovereigns of China. The task of forming the characters he entrusted to the learned Tsang-kie. Happening to walk on the banks of the river, Tsang-kie observed on the sand numerous footsteps of birds. With a pencil dipped in a species of varnish, he contrived to copy the lines formed by these impressions and frame others like them. He delineated in this manner 540 characters, with which he undertook to represent the various objects of nature and art. Hence, it is said, originated the Chinese system of writing, whose design was to draw the outline of every thing which it meant to express, and from which it has never deviated.

Classes of Flowers. "Anne T."—Flowers are commonly classed as bulbs, tubers, herbaceous perennials, biennials, and annuals. The first are chiefly, as well as a few of the tubers, spring flowers, and of course require to be planted in prepared beds, boxes, or pots, in the autumn, sooner or later, according to the place or purpose for which the flowers are wanted. Tulips, hyacinths, and polyanthus-narcissus, are the principal bulbs; together with crown-imperials, gladiolus, crocuses, snow-drops, scillas, &c., are planted in autumn, sooner or later, according to the option or judgment of the manager. Of tubers, the anemone and ranunculus are the chief of the bed flowers; and when a succession of these are wished for, the tubers may be put into the ground at the end of every two months, which will bring the blossoms at corresponding intervals.

J. M.—Hippuric Acid is easily obtained by evaporating gently to a small bulk the fresh urine of the horse or cow, and acidulating with hydrochloric acid. On standing, the liquid deposits brown crystals of hippuric acid, which may be decolorized by a little bleaching liquor and hydrochloric acid. Professor Liebig has lately discovered that this acid is to be found in human urine.—Benzoic Acid is found in gum benzoin, mixed with some resins. It also occurs in the urine of herbivorous animals under certain circumstances, and is likewise formed by the oxidization of the oil of bitter almonds.

Early use of Quills in Writing. M. H.—It has been supposed that quills were made use of for writing so early as the fifth century; but the conjecture rests merely on an anecdote of Theodoric, King of the Ostrogoths; who, being so illiterate that he could not write even the initials of his name, was provided with a plate of gold, through which the letters were cut; and this being placed on the paper, when his signature was required, he traced the letters with a quill. The earliest certain account of the modern writing pens dates no farther back than 638; and the next occurs towards the latter end of the same century, in a Latin sonnet to a pen, composed by Adhelm, a Saxon author, and the first of his nation who wrote in that language. After that period, however, there are numerous proofs of their having been very generally known; but they were so far from having at once superseded the use of reeds, that the latter were commonly used in the eighth century. The classical ancients did not use quills in writing, but metal styles *(styli)*, with which they engraved the characters on tablets covered with wax; but when they wrote with liquids on parchment, or on the paper then manufactured from the Egyptian papyrus, they made use of reeds.

Our Correspondent, who signs himself "Pupil," had better devote his studies to orthography and the general principles of the English grammar, before he aims at scientific objects.

NATURAL PHILOSOPHY.

Second Division.

CHAPTER XLIV.

NATURAL OPTICAL PHENOMENA.

The Rainbow—Conditions of its Appearance—Formation of the Inner Bow—Formation of the Outer Bow—The Bows are Circular Arcs—Astronomical Refraction—Elevation of Objects—The Twilight—Reflexion from the Air—Mirages and Spectral Apparitions, and Unusual Refraction.

The rainbow, the most beautiful of meteorological phenomena, consists of one or more circular arcs of prismatic colours, seen when the back of the observer is turned to the sun, and rain is falling between him and a cloud, which serves as a screen on which the bow is depicted. When two arches are visible, the inner one is the more brilliant, and the order of its colours is the same in which they appear in the prismatic spectrum—the red fringing its outer boundary, and the violet being within. This is called the primary bow. The secondary bow, which is the outer one, is fainter, and the colours are in the inverted order. When the sun's altitude above the horizon exceeeds 42° the inner bow is not seen, and when it is more than 54° the outer is invisible. If the sun is in the horizon, both bows are semicircles, and according as his altitude is greater, a less and less portion of the semicircle is visible; but from the top of a mountain bows that are larger than a semicircle may be seen.

These prismatic colours arise from reflexion and refraction of light by the drops of rain, which are of a spherical figure. In the primary bow there is one reflexion and two refractions; in the secondary there are two reflexions and two refractions. Thus, let S, Fig. 272, be a ray of light, incident on a raindrop, *a*. On account of its obliquity to the surface of the drop, it will be refracted into a new path, and at the back of the drop it will undergo reflexion, and returning to the anterior face and escaping it will be again refracted, giving rise to violet and red and the intermediate prismatic colours between, constituting a complete spectrum; and as the drops of rain are innumerable, the observer will see innumerable spectra arranged together so as to form a circular arc.

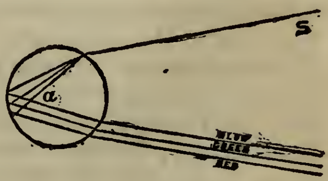

Fig. 272.

The secondary rainbow arises from two refractions and two reflexions of the rays. Thus let the ray S, Fig. 273, enter at the bottom of the drop; it passes in the direction toward I′ after having undergone refraction at the front; from I′ it moves to I″, where it is a second time reflected, and then emerges in front, undergoing refraction and dispersion again. For the same reason as in the other case, prismatic spectra are seen arranged together in a circular arc, and form a bow.

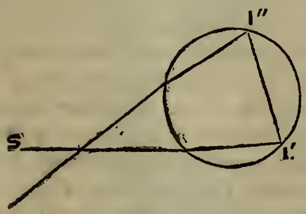

Fig. 273.

In Fig. 274, let O be the spectator, and O P a line drawn from his eye to the centre of the bows. Then rays of the sun, S S, falling on the drops A B C, will produce the inner bow, and falling on D E F, the outer bow, the former by one, and the latter by two reflexions. The drop A reflects the red, B the yellow, and C the blue rays to the eye; and in the case of the outer bow, F the red, E the yellow, and D the blue. And as the colour perceived is entirely dependent on the angle under which the ray enters the eye, as in the case of the interior bow, the blue entering at the angle C O P, the yellow at the larger angle B O P, and the red and the largest A O P, we see the cause why the bows are circular arcs; for out of the innumerable drops of rain which compose the shower, those only can reflect to the eye a red colour which make the same angle, A O P, that A does with the line O P, and these must necessarily be arranged in a circle of which the centre is P. And the same reasoning applies for the yellow, the blue, or any other ray as well as the red, and also for the outer as well as for the inner bow.

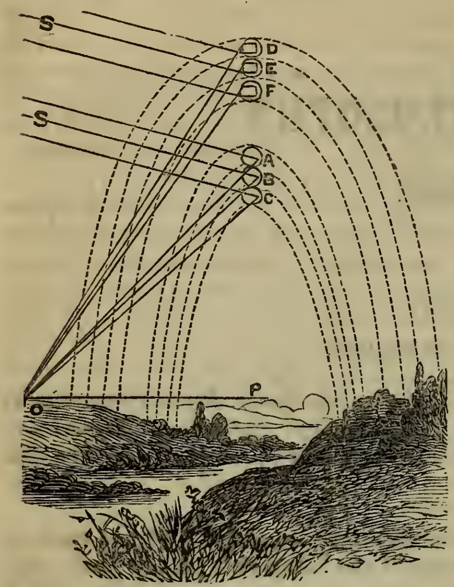

Fig. 274.

Another interesting natural phenomenon connected with the refraction of light is what is called "astronomical refraction," arising from the action of the atmosphere on the rays of light. It is this which so powerfully disturbs the positions of the heavenly bodies, making them appear higher above the horizon than they really are, and changes the circular form of the sun and moon to an oval shape. It also aids in giving rise to the twilight.

Let O, Fig. 275, be the position of an observer on the earth, Z will be his zenith, and let R be any star, the rays from which come, of course, in straight lines, such as R E. Now, when such a ray impinges on the atmosphere at *s*, it is refracted, and deviates from its rectilinear course. At first this refraction is feeble; but the atmosphere continually increases in density as we descend in it, and therefore the deviation of the ray from its original path, R E, becomes continually greater. It follows a curvilinear line, and finally enters the eye of the observer at O. This may perhaps be more clearly understood by supposing the concentric circles *a a*, *b b*, *c c*, represented in the figure, to stand for concentric shells of air of the same density, the ray at its entry on the first becomes refracted, and pursues a new course to the second. Here the same thing again takes place, and so with the third and other ones successively. But these abrupt changes do not occur in the atmosphere, which does not change its density from stratum to stratum abruptly, but gradually and continually. The resulting path of the ray is, therefore, not a broken line, but a continuous curve.

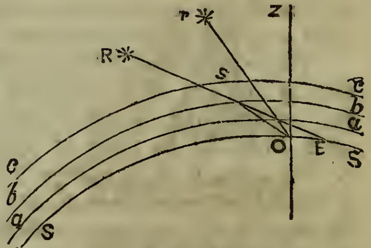

Fig. 275.

Now it is a law of vision that the mind judges of the position of an object as being in the direction in which the ray by which it is seen enters the eye. Consequently the star R, which emits the ray we have under consideration, will be seen in the direction O *r* —that being the direction in which the ray entered the eye—and therefore the effect of astronomical refraction is to elevate a star or other object above the horizon to a higher apparent position than that which it actually occupies. Astronomical refraction is greater according as the object is nearer the horizon, becoming less as the altitude increases, and ceasing in the zenith. An object seen in the zenith is therefore in its true position.

On these principles the figure of the sun and moon, when in the horizon, changes to an oval shape; for the lower edge being more acted upon than the upper, is therefore relatively lifted up, and those objects made less in their vertical dimensions than in their horizontal. Even when an object is below the horizon, it may be so much elevated as to be brought into view; for just in the same way that a star, R, is elevated to *r*, so may one beneath the horizon be elevated even to a greater extent, because refraction increases as we descend to the horizon. Stars, therefore, are visible before they have actually risen, and continue in sight after they have actually set. They are thus lifted out of their true position when in the horizon about thirty-three minutes. In the books on astronomy, tables are given which represent the amount of refraction for any altitude.

What has been here said in relation to a star holds also for the sun; which therefore is made apparently to rise sooner and set later than what is the case in reality. From this arises the important result that the day is prolonged. In temperate climates, this lengthening of the day extends only to a few minutes; in the polar regions the *day* is made longer by a *month*. And it is for this cause, too, that the morning does not suddenly break just at the moment the sun appears in the horizon, and the night set in the instant he sinks; but the light gradually fades away, as a twilight, the rays being bent from their path, and the scattering ones which fall on the top of the atmosphere brought in curved directions down to the lower parts.

The phenomenon of twilight is not, however, wholly due to refraction. The reflecting action of the particles of the air is also greatly concerned in producing it. The manner in which this takes place is shown in Fig. 276, where A B C D represents the earth, T R P the atmosphere, and S O, S′ N, S″ A rays of the sun passing through it. To an observer, at the point A, the sun, at S″, is just set; but the whole hemisphere above him, P R T, being his sky, reflects the rays which are still falling upon it, and gives him twilight. To an observer at B, the sun has been set for some time, and he is in the earth's shadow; but that part of his sky which is included between P Q R *x* is still receiving sun-rays, and reflecting them to him. To an observer at C, the illuminated portion of the sky has decreased to P Q *z*. His twilight, therefore, has nearly gone. To an observer at D, whose horizon is bounded by the line D P, the sky is entirely dark, no rays from the sun falling on it. It is therefore night.

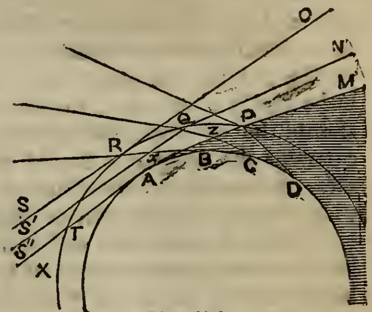

Fig. 276.

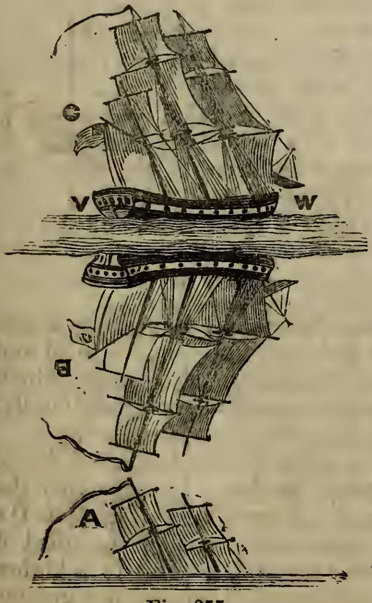

Fig. 277.

The action of the atmosphere sometimes gives rise to curious spectral appearances—such as inverted images, looming, and the mirage. The latter, which often occurs on hot sandy plans, was frequently seen by the French during their expedition to Egypt, giving rise to a deceptive appearance of great lakes of water resting on the sands. It appears to be due to the partial rarefaction of the lower strata of air through the heat of the surface on which they rest, so that rays of light are made to pass in a curvilinear path, and enter the eye. In the same way at sea, inverted images of ships floating in the air are often discovered.

Thus, "on the 1st of August, 1798, Dr. Vince observed at Ramsgate a ship which appeared as at A, Fig. 277, the topmast being the only part of it seen above the horizon. An inverted image of it was seen at B, immediately above the real ship at A, and an erect image at C, both of them being complete and well defined. The sea was distinctly seen between them, as at V W. As the ship rose to the horizon, the image, C, gradually disappeared; and, while this was going on, the image B descended, but the mainmast of B did not meet the mainmast of A. The two images, B C, were perfectly visible when the whole ship was actually below the horizon."

These singular appearances, which have often given rise to superstitious legends, may be imitated artificially. Thus, if we take a long mass of hot iron, and, looking along the upper surface of it at an object not too distant, we shall see not only the object itself, but also an inverted image of it below; the second image being caused by the refraction of the rays of light passing through the stratum of hot air, as is the case of the mirage.

The trembling which distant objects exhibit, more especially when they are seen across a heated surface, is, in like manner, due to unusual and irregular refraction taking place in the air.

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PRACTICAL ESSAYS ON EDUCATION.

THE SCHOOL-ROOM.

In the construction or choice of a school-room, several points ought to be carefully attended to. In the first place, it should be so arranged as to facilitate the evolutions of the pupils, and place them in positions to be easily overlooked by the teacher. It should be of ample size, especially if we consider the danger to health from vitiated air. A benignant Providence has poured over this globe an ocean of fresh, pure air, everywhere some fifty odd miles deep. It has not been parsimonious of this fluid, but has given it to us by "sky-fulls." And why? Because it is indispensable to health.

"We can, at most," says Hufeland, "breathe the same air only four times; for it is then, from the finest support of life, converted by ourselves into the most deadly poison."

Dr. Arnott is most emphatic on this subject: "The most hurtful to man of all aërial poisons," he says, "is that of his own expelled breath, when detained long around him, and breathed again. A considerable proportion of the solid aliment and drink which he receives is thrown off by the lungs, as a kind of excrementitious matter, in the forms of carbonic acid, water, and aëriform organic matter. The last-named portion gives a certain odour to the breath of many persons even in good health; and with impaired health it becomes copious, offensive, and pernicious. This organic matter, probably at first, when it may be called fresh, is harmless; for a mother does not fear to kiss her beautiful child, nor do persons in a crowded church, or other place, where healthy people assemble, much fear their neighbours; but there is no doubt that it soon becomes putrid and noxious."

Because air is an invisible substance, and makes little impression, of itself, on the organs of sense, the great majority of mankind seem to act as if it had no existence. But although the effects of impure air may not be sensibly felt, "it gradually preys," to use the words of Dr. Dick, "upon the constitution, and often produces incurable asthmas, fevers, consumptions, and other dangerous disorders, which are frequently imputed to other causes."

In March, 1836, mention was made in Parliament of a school at Norwood for London pauper children, at the time containing nearly seven hundred, when thirty had died within a short time, and the rest were said to be nearly all unwell, owing, it was thought, to scanty or bad food supplied to them by the proprietors. On the following day, the Poor Law Commissioners requested Dr. Arnott—from whom we derive the information—to visit the school, and to report. On his way out he visited another school, containing one hundred and fifty children of the same class, on Brixton Hill. This was not crowded, and the children, among whom only two had died in three years, looked remarkably healthy. On entering a room of the Norwood school, in which nearly three hundred boys were present, Dr. Arnott was struck by the offensive state of the atmosphere; although the air, on a cold day, from want of ventilation was hot and foul; and in such air the children lived through both days and nights. The children all had a pale, unhealthy look, and on inquiry it was found that every form of scrofulous disease abounded among them—swelled glands, skin eruptions, sore eyes, scald-head, diarrhœa, dropsy, and fever. The food given to them, however, the doctor found to be better than what is usually supplied in establishments of the kind, and the evident cause of their illness was want of fresh air. He reported accordingly. The faults being remedied, the school became as remarkable for the good health of the scholars, as for their number (which soon exceeded one thousand), and the excellent educational arrangements.

The life of Crabbe the poet, written by his son, also contains a profitable illustration. When about ten or eleven years old, the embryo poet was sent to a school at Bungay. "Soon after his arrival he had a very narrow escape. He and several of his school-fellows were punished for playing at soldiers, by being put into a large dog-kennel, known by the terrible name of the *Black Hole.* George was the first that entered; and the place being crammed full with offenders, the atmosphere soon became pestilentially close. The poor boy in vain shrieked that he was about to be suffocated. At last, in despair, he bit the lad next to him violently in the hand. 'Crabbe is dying — Crabbe is dying,' roared the sufferer; and the sentinel at length opened the door, and allowed the boys to rush out into the air. My father said 'a minute more, and I must have died.'"

According to Dr. Andrew Combe, every individual breathes from fourteen to twenty times in a minute, and inhales from fifteen to thirty cubic inches of air at each inspiration. Reckoning fifteen inspirations to a minute, and twenty cubic inches of air to each inspiration, one man or woman breathes on an average three hundred cubic inches of air every minute. At each inspiration, *one-half* of the *oxygen* is consumed, and its place is supplied by *carbonic acid,* which is a *poisonous gas,* formed by the combination of part of the consumed oxygen with *carbon,* obtained from the venous blood and food. So that every time the air is breathed, it is not only robbed of a portion of that element which is the support of life, but it also receives an additional portion of another element destructive of life.

The doctor has some excellent remarks on the influence of pure air on the mental faculties, which I here transcribe. "When I called to mind," he says, "the freshness and alacrity with which, when at school, our morning operations were carried on, the gradual approach to langour and yawning which took place as the day advanced, and the almost instant resuscitation of the whole energies of mind and body that ensued on our dismissal, I could not help thinking that, even after making every deduction necessary for the mental fatigue of the lessons, and the inaction of the body, a great deal of the comparative listlessness and indifference was owing to the continued inhalation of an air too much vitiated to be able to afford the requisite stimulus to the blood, on which last condition the efficiency of the brain so essentially depends. This became the more probable, on recollecting the pleasing excitement occasionally experienced for a few moments, from the rush of fresh air which took place when the door was opened to admit some casual visitor."

The accuracy of these remarks was confirmed by an experiment made by a teacher at Edinburgh, in 1834. At the recommendation of Dr. Combe, he permitted his pupils to play in the open air for ten minutes, at the end of the first hour. During this period the door and windows were thrown open, and the air renewed. "The effect of this proceeding," remarks the learned doctor, "during last winter, was a marked increase in the mental activity and attention of the pupils, greater pleasure and success in the exercises, and a striking diminution in the number of absentees from sickness."

I know the practical difficulties of arranging such a plan of study as the above; but the statement is interesting, and may be remembered with benefit.

Erasmus Wilson, in his valuable work, *On the Management of the Skin as a means of Promoting and Preserving Health,* says:—"Rooms, in which a number of persons are breathing, soon become contaminated, and we are frequently made acquainted with this condition of an apartment by the detection, on entering it, of a peculiar faint odour, which is soon lost when we mingle with the crowd. . . . . By a wise Providence, odours dangerous to life are generally disagreeable, and cannot be too carefully avoided."

The subject of warming the school-room is also one that demands care and skill. The lighting of it should be so managed as to spare the eyes of the children. Dr. Reynolds remarks, "How much talent lies dormant through the sensitiveness of the eye-sight, occasioned by inordinate and untimely use of the eyes. This last-mentioned evil is increasing among the young. Accurate inquiries have convinced me that a large number of these individuals must go back to the school-room to find the source of their infirmities."

Dr. Howe, an American physician, says, "There are some obvious dangers to which children are exposed in schools, which may be pointed out in a few words. You will often see a class of children reading or writing with the sun shining on their books, or writing in a dark afternoon with their backs to the window, and their bodies obstructing its little light. . . . . This is, there can be no doubt, a cause of evil, and so surely as it exists, it will be followed by its effect. A boy reading by twilight, or by the blaze of a fire, or by moonlight even, will tell you he does not feel the effects ; nevertheless, they follow as closely as the shadow upon the substance ; and if, ten years afterwards, you see the boy selecting glasses at an optician's, and ask him what caused his imperfect vision, he will tell you that there was no *particular* cause; that is, the amount of evil done at any particular time was not perceptible—as a toper, whose system is tottering to ruin, cannot believe that any *particular* glass of spirits ever did him any harm. We should never read but in the erect posture; we should never read when the arterial system is in a state of high action ; we should never read with too much or too little light; we should never read with the dazzling light of the sun or fire striking on our face. School-rooms should be arranged in such a manner that the light of the sun can be admitted in the right direction, not dazzling the eyes, but striking upon the books. There should be facilities for admitting the light fully in dark weather, and for excluding it partly when the sun shines brilliantly."

There is another point which I must not neglect to mention. The teacher should take care that his pupils do not sit in positions which are likely to injure their health, or establish awkward habits. We have the testimony of physicians to warn us of the painful fact, that constitutional diseases, and often incurable bodily deformity, arise from the want of attention to this rule.

The body is the tenement of the soul,—the setting of an immortal gem. The mind and spirit are linked in such close sympathy with the body, that, if this be weak or diseased, it entails misery on the whole being. If the tenement be ill-built, shattered, and leaky, the tenant must necessarily suffer. A great deal of the irritability of temper which we see in some persons arises from imperfect health. If, then, it is important to guard the happiness, and insure the usefulness of the children intrusted to a teacher's care, let him see, at least as far as in him lies, or his opportunities permit, that their physical powers are duly perfected.

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LESSONS IN NATIONAL HISTORY.

No. V.

"The age of mystery, with its hoarded power,
That girt the tyrant in his storied tower,
Has passed and faded like a dream of youth,
And riper eras ask for history's truth."
HOLMES.

CHINA AND ITS REVOLUTIONS.

HITHERTO we have been engaged with the earlier annals of this ancient land. Our first article was chiefly devoted to the remote periods of her mythological and semi-fabulous ages; and the second entered upon her ancient dynasties and their numerous changes, until the sovereignty was eventually settled in the celebrated princes of the house of TANG. With this dynasty we have to resume our historical review; and it may be truly averred, that at no period do the annals of China shine with more radiant lustre. In fact, she was then the only country in the world where civilization and the arts had found a resting-place. The glories of Egypt and of Greece had passed away. Rome had fallen before the ruthless hands of barbarian invaders; and Christian Europe was involved in mediæval darkness and all the anarchy of civil and religious contest. It was just at this period, however, that Mahomet, the celebrated founder of a new religion, A.D. 622, appeared like a blazing meteor in the political world; when his victorious successors, the Saracens, overran the fairest portions of the globe, and eventually established, on the ruins of ancient civilization, the brilliant dynasty of the Caliphs. But while Egypt and Palestine, Assyria and Persia, Mauritania and Iberia, fell before their all-conquering legions, China remained unassailed, and stood alone in all the plenitude of Eastern grandeur.

LI CHIMIN, the son of the founder of the TANG dynasty, at the commencement of the seventh century, was one of the most celebrated monarchs in Eastern annals. Like Harun Al Raschid, he was famed alike for his wisdom and nobleness of character, for his conquests and good government, and for his temperance, cultivated taste, and general patronage of literature. While still Prince of Tang he contributed greatly to his father's elevation, in place of the imbecile princes of the family of Sui, and to the extension of his sway over the regions of Central Asia. On his father's resigning to him the sovereignty, A.D. 627, he assumed the title of Tai-tsung, and still farther extended his victorious arms. One of his first acts was to establish schools, and institute a system of literary examinations. He ordered a complete and accurate edition of all the classics to be published under the supervision of the most learned men in the empire, and honoured the memory of Confucius with special ceremonies of respect. He drew up a code of laws for the direction of his high officers in their judicial functions, and made progresses through his dominions to inspect the condition of the people. His frontiers reached from the borders of Persia, the Caspian Sea, and the Altai of the Kirghis stepp, along those mountains to the north side of Cobi, eastward to the Inner Hingan.

Theodosius, the Greek emperor, sent an envoy to Singan in 643, carrying presents of rubies and emeralds, as did also the Persians. The Nestorian missionaries also presented themselves at court. Tai-tsung received them with respect, and heard them rehearse the leading tenets of their doctrine. He ordered a temple to be erected at his capital, and had some of their sacred books translated for his examination; though there is no evidence now remaining that any portion of the Bible was done into Chinese at this time.

Tai-tsung was succeeded by his son, Kautsung, whose indolent imbecility appeared the more despicable after his father's vigour; but his reign fills a large place in Chinese history, from the extraordinary career of his empress, Wu Tsihtien, or Wu-hau, as she is called, who, by her blandishments, though originally a mere dependent of the royal harem, obtained entire control over him. As soon as she became empress, Wu began gradually to assume more and more authority, until, long before the emperor's death, she engrossed the whole management of affairs, and, at his demise, openly assumed the reins of government, which she wielded for twenty-one years with no weak hand. When she was disabled by age, her son, Chungtsung, supported by some of the first men of the land, asserted his claim to the throne, and, by a palace conspiracy, succeeded in removing her to her own apartments, where she died, aged 81 years.

A race of twenty monarchs swayed the sceptre of the house of Tang; but after the demise of the empress Wu Tsihtien, none of them equalled Tai-tsung; and the Tang dynasty at last succumbed to ambitious ministers lording over its imbecile sovereigns.

The last three or four emperors exhibited the usual marks of a declining house; and the general of Chautsung rose against his master, and destroyed him, A.D. 903, and soon after compelled his son, Chau-siuen-ti, to abdicate, A.D. 907.

Numerous competitors arose against the regicide, and the new emperor was unable to extend his sway beyond the provinces of Honan and Shantung. After a short reign of six years, he was killed by his brother Liang Chu-tien, who, on his part, fell under the attack of a Turkish general, and ended this dynasty, A.D. 923, after a duration of sixteen years.

The conqueror called himself Chiwangtsung, and his dynasty Tang, as if in continuation of that line of princes; but this mode of securing popularity was unsuccessful. Like many of the Roman emperors, he was killed by his troops, who chose a successor; and his grandson, unable to resist his enemies, burned himself in his palace, A.D. 936, and ended the dynasty, after continuing thirteen years.

The Tartars now endeavoured to subdue the whole country; but were repulsed by a loyal general, who assumed the yellow, and called his dynasty after the renowned house of Han. He and his son held sway four years, till A.D. 951, and then were cut off.

Ko Wei, the successful aspirant to the throne, maintained his seat, but died in three years, leaving his power to an adopted son, Shitsung, whose vigorous rule consolidated his still unsettled sway. His early death, and the youth of his son, decided his generals to bestow the sceptre upon Chau Kwangyu, one of their own number, lately appointed tutor to the infant monarch, which closed the After Chau dynasty, A.D. 960, after a brief duration of nine years.

These short-lived houses, between A.D. 907-960, are known in Chinese history as the WU-TAI, or FIVE DYNASTIES.

During this period Europe was distracted by the wars of the Normans and Saracens, and learning then was at a low ebb.

The SUNG Dynasty began A.D. 970, and maintained its power over the whole empire under nine sovereigns, for 157 years, till A.D. 1127. The mode in which its founder was made head of the state, reminds one of the way in which the Prætorian guards elevated their chiefs to the throne of the Cæsars. After the military leaders had decided upon their future sovereign, they sent messengers to announce to him his new honour, who found him drunk with wine, and "before he had time to reply, the yellow robe was already thrown over his person." His successors were unable to maintain themselves against the Kin Tartars, who compelled them to pay tribute from time to time, and at last drove them south of the Yellow River, A.D. 1118, and kept possession of part, or all that region, under ten princes, until A.D. 1235.

The SOUTHERN SUNG Dynasty forms part of the preceding in reality; but, from the loss of the northern half of the country, is thus designated. From A.D. 1127 to 1280, under nine emperors, its princes continually gave way to the power of Kublai Khan and his fierce Mongols, whom Litsung, about 1245, called in to help him against the Kin, until Ti-Ping, the last scion of the house, drowned himself, with his adherents, off the mouth of the Pearl River, near Canton. The subjugation of the southern parts of the country was attended with great slaughter.

The YUEN Dynasty was founded by Kublai, who soon succeeded in reducing his extensive dominions to order, gaining the good opinion of all his subjects by his equable rule and disposal of offices. He was a vigorous and magnificent prince, and had the advantage of having his acts and splendour related by Marco Polo. The Grand Canal, which was dug during his reign, is a lasting monument of his sagacity and enlightened policy.

The Mongols retained their power under the reign of Ching-tsung, or Timur-khan, a grandson of Kublai, and Wu-tsung, or Genesek-khan, a nephew of the former; but their successors met with opposition, or were destroyed by treachery.

Chu Yuenchang, a plebeian by birth, and formerly a priest, raised the standard of revolt, and finally expelled the Mongols, A.D. 1368, after a durationof 89 years.

Like most of the preceding dynasties, the new one established itself on the misrule, luxury, and weakness of its predecessors.

Hungwu, as Chu Yuenchang called himself on his accession, was the founder of the MING or "Bright" dynasty. He established his capital at Kiangning-fu, or Nanking, on the Yangtsz'kiang, and after a reign of thirty years transmitted the sceptre to his grandson, Kienwăn, a youth of sixteen. Yungloh, his son, dissatisfied with this arrangement, overcame his nephew, seized the crown after five years, and removed the capital to Shuntien-fu, or Peking, in Chih-li.

This prince is distinguished for the code of laws framed under his auspices, which has, with some modifications and additions, ever since remained as the basis of the administration.

During the reign of Kiahtsing, the Portuguese came to China, and in that of Wanleih, about 1580, the Jesuits gained an entrance into the country. In his time, too, the Eastern Tartars, whom the Mongols had driven away, again became numerous and troublesome, and took possession of the northern frontiers.

The first chieftain of the MANCHUS, who attained celebrity, was Tienming, who, in 1618, published a manifesto of his designs against the house of Ming, in which he announced to Heaven the seven things he was bound to revenge. These consisted of petty oppressions upon persons passing the frontiers, assisting his enemies, violating the oath and treaty of peace entered into between the two rulers, and killing his envoys.

The fierce nomad had already assumed the title of Emperor, and "vowed to celebrate the funeral of his father with the slaughter of 200,000 Chinese." Tienming overran the north-eastern parts of China, and committed unsparing cruelties upon the people of Liautung; but died in 1627, before he had satisfied his revenge, which he left, with his army, to his son, Tientsung.

The Chinese army fought bravely, though unsuccessfully, against the warlike Manchus, whose chief not only strove to subdue, but endeavoured, by promises and largesses, to win the troops from their allegiance. The apparently audacious attempt of this small force to subdue the Chinese, was assisted by numerous bodies of rebels, who, like wasps, sprang up in various parts of the country, the leaders of each asserting his claims to the throne, and all of them rendering their common country an easier prey to the invader. One of them, called Li Tsz'ching, attacked Pekin; and the last emperor, Hwai-tsung, feeling that he had little to hope for after the loss of his capital, and had already estranged the affections of his subjects by his ill-conduct, first stabbed his daughter, and then hung himself, in 1643; and thus terminated the race of Hungwu, after 276 years.

The usurper received the submission of most of the eastern provinces; but the Chinese general, Wu Sankwei, in command of the army on the north, refused to acknowledge him, and making peace with the Manchus, invoked the aid of Tientsung, in asserting the cause of the rightful claimant to the throne. This was willingly agreed to. The united army marched to Pekin, and speedily entered the capital; whereupon the MANCHUS declared themselves the rulers of the empire, and thus was established the TSING, or "Pure" Dynasty.

We have now arrived at the establishment of the present reigning dynasty of China, which occupies a most important position in modern history. The vast events connected therewith, and their momentous results, will occupy our next number.

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INORGANIC CHEMISTRY.

CLASS II. METALS OF THE ALKALINE EARTHS.

XIX. BARIUM.

Equivalent, 68·55. *Symbol*, Ba.

BARIUM is a silver-white malleable metal, which is easily oxidized, and melts below a red heat. It was procured by Davy by a process similar to that which yielded potassium, &c. It is better obtained by passing vapour of potassium over baryta (oxide of barium) heated to redness in an iron tube. Mercury dissolves out the reduced metal, and the amalgam is then distilled.

Baryta, or Protoxide of Barium, BaO.—Baryta is best obtained by decomposing the nitrate at a red heat. It is a dry, gray powder, which combines with water to form a hydrate, slaking with the evolution of great heat and even light. The hydrate dissolves in two parts of hot water, or twenty of cold, and crystallizes in flat tables. The aqueous solution is a valuable re-agent.

Sulphate of baryta, or heavy spar, is found abundantly as an associate of other minerals in veins; and from it, or the native carbonate of baryta, all the artificial compounds of barium are formed.

The Peroxide of Barium, BaO_2, is formed by passing pure oxygen gas over the oxide heated to redness in a porcelain tube. It is chiefly interesting as being the means of procuring the peroxide of hydrogen (410).

Chloride of Barium, $BaCl+2HO$.—This salt occurs in white tabular crystals, containing two equivalents of waters which are expelled by heat. It dissolves in a little more than twice its weight of cold water, and the solution is a valuable re-agent for detecting the presence of sulphuric acid.

The Nitrate of Baryta, (BaO,NO_5O) is also a soluble white salt, which crystallizes in anhydrous octahedrons, and dissolves in eight parts of cold or three parts of hot water. Both it and the chloride are prepared by dissolving the native or artificial carbonate in the proper acid.

Sulphate of Baryta—Heavy Spar, (BaO, SO_3), is a mineral found abundantly in many places in this country, as at Cheshire, Ct. It crystallizes in tabular modifications of the rhombic prism, often very beautiful. Its high specific gravity (4·3 to 4·7) gives it the name of *heavy spar*. It is quite insoluble in water or acids, and not easily decomposed. When strongly heated with charcoal powder, however, it suffers decomposition ($BaO, SO_3+4C=BaS+4CO$) ; carbonic oxide is given off, and the soluble sulphuret of barium may be dissolved out from the coaly mass.

Sulphate of baryta is extensively ground up as a pigment, being mixed with white lead as an adulteration.

Carbonate of Baryta, BaO, CO_2, or the *witherite* of mineralogists, is a mineral of some interest, and useful as the chief source of the various compounds of baryta. All the soluble baryta salts are poisonous, and their presence may always be detected by sulphuric acid, with which they form an insoluble sulphate.

XX. STRONTIUM.

Equivalent, 43·78. *Symbol*, Sr.

Strontium is obtained from its oxide in the same manner as barium, and like it is a white metal, oxidized easily in air, and decomposing water at common temperatures. There are two oxides, the protoxide and the peroxide of strontium, similar in properties to the like oxides of barium. The sulphate of strontia (*celestine*), is a rather abundant mineral, and the carbonate (*strontianite*), is much esteemed by mineralogists. They are very similar in properties to the sulphate and carbonate of baryta.

The Chloride of Strontium ($SrCl+9HO$) is a deliquescent salt, soluble in two parts of cold water. It loses its water of crystallization by heat. Both it and the nitrate of strontia (SrO, NO_5) are much employed by pyrotechnists in forming the *red fire* of theatres and fire-works. All the compounds of strontium give a peculiar red tint to the flame of the blowpipe, while the barytic salts do not. The salts of strontia are not poisonous.

XXI. CALCIUM.

Equivalent, 20. *Symbol*, Ca.

Calcium is a yellowish-white metal, obtained like barium, and has so strong a disposition to combine with oxygen, that it is difficult to observe its properties.

Protoxide of Calcium—Lime, CaO.—This most valuable substance, so well known as *quick-lime*, is procured in a state of great purity by heating stalactites in a close crucible for some hours. The carbonic acid and organic colouring matters are driven off, and pure white oxide of calcium remains. This is an infusible, rather hard body, having a great affinity for carbonic acid and for water, with which it combines to form a hydrate, evolving great heat. The preparation of common mortar used in building illustrates this property on a large scale. The dry hydrate is a bulky powder, having one equivalent of water, which may be again expelled by heat. It is soluble in about 500 parts of cold, and less so in hot water. The solution (*lime water*) is a very valuable re-agent to the chemist, and is also used as an antacid in medicine. Exposure to air decomposes it, forming the carbonate of lime. The solution has a strong, disagreeable alkaline taste, and changes vegetable colours.

Common lime is prepared by heating limestone (carbonate of lime) in large stone furnaces, filled from the top with the limestone and fuel: the fire is kept up constantly, by renewed charges of the materials at top, while the prepared caustic lime is drawn out at the bottom.

Mortar acts as a cement by the slow formation of a carbonate of lime, which binds together the grains of sand that make up the greater part of the mortar. The smaller the portion of lime used, the more firm will be the cement at last; but it is then so much more difficult to work, that an excess of lime is usually employed. The presence of oxide of iron and manganese, of alumina, magnesia, silica, and other like substances, in a limestone gives the lime prepared from it the property of hardening under water, which is hence called *hydraulic lime*.

Lime is much used in improved agriculture as a manure. It acts to decompose vegetable matters, to neutralize acids, dissolve silica, and retain carbonic acid. It is always present naturally in every fertile soil, and is a constant ingredient in the ashes of most plants.

Chloride of Calcium, CaCl.—The solution of lime, or its carbonate in hydrochloric acid to saturation, gives us this salt. It is, when fused, a white crystalline solid, with a great avidity for moisture, and for this reason it is used in the desiccation of gases, &c. It is soluble in alcohol, with which it forms a definite crystallizable compound. It forms a powerful freezing mixture with ice.

The sulphurets and phosphurets of calcium have little interest. The phosphuret being decomposed by water is an available source of the spontaneously inflammable phosphureted hydrogen.

Sulphate of Lime — Gypsum — Selenite, CaO, SO_3.—This salt in the form of hydrate (CaO, SO_3+2HO) is abundant in nature, and is much used in agriculture as a manure, being ground to powder, and after expelling the water by heat, as a material for stucco and plaster casts. It is then commonly known as "plaster of Paris." When crystallized in transparent flexible plates, it is called *selenite.* Anhydrous gypsum also is sometimes found native, and is known by the mineralogical name of *anhydrite.* Gypsum is frequently associated with rock-salt. It is soluble in about 500 parts of water, and is present in most natural waters. By a heat of 200° to 300° it loses its water of composition, and when the anhydrous powder is moistened, the lost water is regained, and it becomes solid; but if overheated this result does not happen.

Fluoride of Calcium—Fluor Spar, CaF.—This is a rather abundant mineral, being found beautifully crystallized of various colours, in the cube and its modifications. It is the principal source from which we obtain the hydrofluoric acid, by decomposition with sulphuric acid. It often phosphoresces very beautifully with heat, and emits a green, yellow, or purple light, at a temperature below redness.

Phosphates of Lime.—There are several phosphates of lime corresponding to the various phosphoric acids. The earth of bones is a tribasic phosphate of lime, and the mineral known as apatite is also a phosphate of lime. The phosphates of lime are insoluble in water, but dissolve in dilute acids. All cereal grains, and many other vegetables, contain phosphate of lime in their ashes.

Carbonate of Lime—Marble—Calcareous Spar, CaO, CO_2.—This is one of the most abundant minerals of the earth, forming in limestone vast mountains and wide spread geological deposits. It occurs most superbly crystallized in rhombohedral forms, which constitute brilliant ornaments in mineralogical collections. It is soluble in dilute acids, with escape of carbonic acid, and is also decomposed by heat, leaving quick-lime.

Chloride of Lime—Bleaching Powder.—This valuable compound is formed when chlorine gas is gradually admitted to hydrate of lime slightly moist and kept cool. The chlorine is absorbed largely, and the *bleaching-powder* of the arts is formed. It is a soft white powder, easily soluble in about 10 parts of water, giving a highly alkaline solution, which bleaches feebly. It is employed by dipping the goods in a weak solution of chloride of lime, and then in very dilute sulphuric acid. The chlorine is thus evolved and does its work. Several repetitions are needed to complete the process. This compound emits a strong smell, which is similar to chlorine, but is due to hypochlorous acid; it is very useful for disinfecting offensive apartments, and its energy is increased by the addition of a little acid. The disinfecting liquid of Labarraque is a compound of chlorine with soda, similar in composition to solution of bleaching-powder.

The chloride of lime is now known to be a mixture of chloride of calcium and hypochlorite of lime.

XXII. MAGNESIUM.

Equivalent, 12·67. *Symbol, Mg.*

Magnesium is obtained by decomposing the chloride of that metal heated to redness in a glass tube, by passing over it the vapour of potassium or sodium. Chloride of potassium or sodium is formed, and the metallic magnesium is separated by dissolving out the soluble chloride.

It is a white metal, malleable and brilliant. It fuses with a red heat, and if heated to redness in the air, burns with a brilliant light, becoming oxide of magnesium. It does not tarnish in the air, and does not decompose water even at 212°, but dissolves in acids with escape of hydrogen.

Oxide of Magnesium—Calcined Magnesia, (MO.)—This substance is left when the carbonate of magnesia is heated to redness. It is a white, earthy powder, insoluble in water, but readily dissolves in weak acids. It occurs in nature crystallized in regular octahedrons, forming the mineral *periclase*, It is much used in medicine as a mild and efficient aperient. The hydrate of magnesia MgO, HO) is formed when magnesia is precipitated from its solutions by an alkali. Heat expels the equivalent of water. The hydrate is found beautifully crystallized in thin pearly plates at Hoboken, New Jersey.

Chloride of Magnesium ($MgCl$.) — This salt is best prepared by neutralizing equal portions of hydrochloric acid, one with magnesia and the other with ammonia, mixing the two portions, and evaporating to dryness. The dry mass is heated in a covered crucible as long as sal ammoniac is given off, when pure chloride of magnesium is left. It is a very deliquescent salt, and supplies the means of procuring metallic magnesium. When magnesia is dissolved in hydrochloric acid, a hydrated chloride of magnesium results. By heat the water is expelled, carrying with it hydrochloric acid,.and leaving pure magnesia behind. Chloride of magnesium exists in sea-water. The iodide and bromide of magnesium are also soluble salts, but the fluoride is insoluble.

Sulphate of Magnesia—Epsom Salts (MgO, SO_3+7HO.) — This well-known salt is easily formed by dissolving magnesia or its carbonate in sulphuric acid. It is made on a large scale by dissolving serpentine rock in strong sulphuric acid. It is very soluble, and like all the soluble salts of magnesia, has a peculiar bitter taste.

The Carbonate of Magnesia is found native in magnesian rocks, and is formed artificially by decomposing any of the soluble salts of magnesia by an alkaline carbonate. It is insoluble in water; but a solution of carbonic acid dissolves it, and forms the celebrated *Murray's solution of Magnesia*. It is decomposed by contact of air, carbonic acid escapes, and carbonate of magnesia is thrown down.

Phosphate of soda with ammonia throws down a crystalline insoluble salt, from magnesian solutions, which is the double phosphate of magnesia and ammonia. This is the most ready mode of testing for the presence of magnesia.

Magnesia occurs abundantly in nature as a constituent of many minerals, as well as in the form of hydrate and carbonate. It is present in nearly all fertile soils, and constitutes an important part of the inorganic matters in the husk and seeds of many plants. The potato especially contains a large portion of the ammonio-phosphate of magnesia, and hence bran is a useful manure for the potato, because it is peculiarly rich in this salt.

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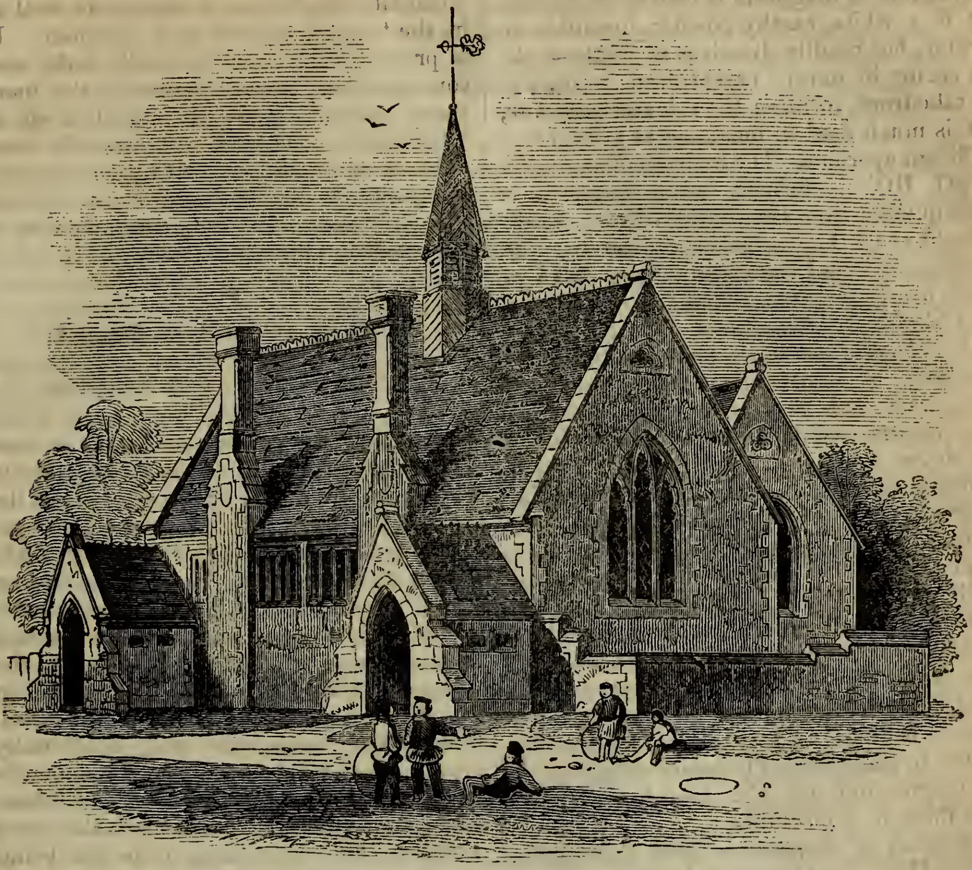
PUBLIC SCHOOLS.—No. III.

ST. ANNE'S SCHOOLS AT EDGEHILL, LIVERPOOL.

Liverpool, in a commercial point of view is not only the most enterprising place in the world, but she is, at the same time, the great promoter of every object which contributes to educational progress, or to the intellectual development of the human mind. Her literary, scientific, and scholastic institutions, though but the growth of a century, are calculated to excite the astonishment of every foreigner ; and, in all the suburban districts of Liverpool, educational institutions are continually springing up, in proportion to the demands of her ever-increasing population. Of these districts, Edgehill is amongst the most populous and important, from its being a great centre of the vast railway traffic of this busy locality ; and here St. Anne's Schools, of which we have given the annexed view, have been recently erected. The architecture is of a simple and unassuming character,—the small turret, or louvre, and the porches of entrance, being the most prominent features. Utility, and not ornament, has been the main object of the founders. There is, however, something very agreeable in the variety occasioned by the alternation of the four eaves-windows with the three gabled ones ; but the variety would have been still more pleasantly increased if the former had terminated with horizontal lintel-stones.

The general plan of these schools is according to the design of Mr. W. W. Lloyd, architect, of Liverpool ; and the material of which they are constructed is Wolston stone. They consist of a boys' school above, 87 feet 3 inches by 30 feet, by 15 feet high at the springing, and 44 feet in the centre of the roof, which is open



ST. ANNE'S SCHOOLS, EDGEHILL, LIVERPOOL.

to the room (the timber of the same being chamfered, stained, and varnished);—of a girls' school, 40 feet 4 inches by 30 feet, by 15 feet high;—and of an infant school, 39 feet 5 inches by 30 feet, by the same height, with a passage to the churchyard between. The schools have large play-grounds at the ends of the building. There is a louvre in the roof for ventilation, and the fresh air is admitted into each school by slides in the window bottoms.

Speaking of Edgehill, where these schools are erected, and the vast population and traffic of the neighbouring localities, a writer in the "Land We Live In," thus expresses himself:—"Let any one, starting from the visible railway at the eastern margin of Liverpool, near Edgehill, go across or through the mass of streets from thence to Lime Street, Duke Street, King Street, Crown Street, Brown Street, Copperas Hill, and all the rest, he will be walking over the tunnel which conveys all the passenger-trains to the central station in Lime Street, a distance of a mile and a quarter. Let him retrace his steps, and find his way in the straightest possible line from Edgehill to Wapping, near the King's Dock—passing a mass of streets somewhat to the south of the passenger-tunnel—he will now be walking over the goods' tunnel, which conveys all the merchandise to and from Edgehill and Wapping, a distance still greater than that traversed by the passenger-tunnel. From Wapping the tunnel proceeds, for about one-sixth part of a mile, on a level, and then ascends, for upwards of a mile, at a uniform gradient of one in forty-eight, to the vast excavated area at Edgehill, where both the tunnels meet. The amount of goods that passes through this tunnel must be enormous. Since the amalgamation of the Liverpool and Manchester with other companies, the accounts have not been published separately; but in 1844, when the company was yet independent, the receipts from goods' traffic, on this line of only thirty miles's length (and a few short branches), amounted to nearly a hundred and twenty thousand pounds, and still farther works are in progress."

Amidst all this commercial prosperity and enterprise, it is a matter of congratulation, that the interests of education and intellectual progress—so essential to the well-being of society—are not entirely neglected.

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THE COSMOS INSTITUTE.

Societies for the cultivation or advancement of particular branches of human knowledge existed, both on the Continent and in this country, before the end of the 16th century. In Italy, the *Florentine Academy* and the *Academia della Crusca* had been founded with the view of improving the language and literature of that country. France had its *Academy of Painting and Sculpture,* and its *Royal Academy of Inscriptions;* and the *Antiquarian Society* in England was founded in 1572. With the exception of the persons connected with these institutions, who were engaged in the pursuit of letters, the fine arts, and antiquities, the learned world was in that and the preceding ages chiefly occupied with scholastic philosophy. But the discoveries of Galileo in astronomy and mechanics having opened a field for research in those sciences, men of learning began to turn to pursuits, which, while they seemed to constitute a worthy exercise of human intellect, promised to lead to results of great practical utility.

England appears to have led the way to the formation of a body of men who sought by mutual co-operation to advance the *new philosophy,* as it was called; for Dr. Wallis, in an account of his own life, relates, that in 1645 several persons, chiefly professors of Gresham College, who then resided in London, at the suggestion of a Mr. Haak, a native of Germany, joined themselves into a sort of club, in which, purposely excluding politics and theology, they agreed to communicate to each other the results of their researches in chemistry, medicine, geometry, astronomy, mechanics, magnetism, navigation, and experimental philosophy in general.

This society—comparatively insignificant in its infancy—was destined, in its maturity, to hold a most distinguished place in the annals of science. Its members having presented an address to Charles II. on his restoration, his Majesty expressed much satisfaction at the progress made by the society, and promised to support it with his influence. And in 1662 he granted a charter, by which the members were incorporated into a Society, consisting of a president, council, and fellows, under the name of the *Royal Society.* By 1664, the *Royal Society of London* was completely formed, and it must be considered as the oldest of its kind in Europe, if we except the *Academy of the Lyncei* at Rome, which took its rise in 1611.

During many years the Royal Society may be said to have been the depository of nearly all the science of the country; but that science became at length too extensive to be adequately cultivated by one body of men; and then separate and independent societies formed themselves, each having in view the promotion of one particular branch of the philosophy of nature, or one branch of the arts. The labours already accomplished by these associations are such that the Royal Society may be justly proud of them as the works of her children; and the high place which she continues to hold, in the promotion of the sciences generally, cannot fail to inspire the societies themselves with reverence for the body from whence they diverged.

The utility of these societies is so readily evident, that it would be idle for us to enlarge upon the facilities they afford, or the stimulus they create, for the advancement of philosophical research. But we may be excused, if we enlarge upon another class of institutions which have recently risen up among us; such as the Polytechnic and Panopticon Institutions. They appear well adapted for the purposes they were intended to fulfil—the promulgation of science among the middle and lower classes; persons whose times are occupied chiefly in other matters, but who are sufficiently refined and anxious to acquire some knowledge of the laws which govern the universe and its inhabitants. The number of such institutions may, we think, be extended with advantage.

We are glad, therefore, to learn, that it is proposed to establish another of these useful institutions; one which will contain all the characteristic costumes and productions of every nation and tribe in the world. This proposed society—this museum of mankind—is to be called the COSMOS INSTITUTE.

Most of our readers are aware, that Mr. Wyld, in the Great Exhibition year, opened, in a new building in Leicester Square, a Great Model of the Earth; with collections of ancient and modern maps, &c., &c. The new society proposes to extend the plan of this Institution, to cover nearly the whole area with suitable buildings, embracing large rooms and galleries. Lecture theatres are to be built, in which regular courses of lectures and demonstrations are to be given in Physical Geography; upon Man, in relation to the world he inhabits; and upon matters of general Geographical, Hydrographical, and Ethnological interest. Large meeting rooms, and apartments for persons connected with the scientific, artistic, and literary societies, whose pursuits are in unison with the special object of the Cosmos Institute, are also to be erected.

Whilst it is intended to maintain the Large Model of the Earth in its present position, it is proposed to add to the present extensive collection of ancient and modern maps, charts, and books, all the maps, charts, and geographical works published throughout the world; and to invite the assistance of Foreign Governments and Societies to contribute all their maps, charts, and geographical works, published under the sanction of the *State* (many of whom have already kindly offered their publications), so that proprietors and the public may have immediate access to the best sources of information on every subject connected with Geography, Hydrography, and the allied sciences.

It is further proposed to maintain a competent body of Demonstrators and Lecturers, who shall deliver regular courses of lectures upon Physical and Political Geography and Ethnology, not only within the Model, but also in the theatres of the Institute, so as to embrace all the requirements of a great Geographical School; to hold meetings of the members, at which scientific papers shall be read and discussed; and to uphold a library and reading room, where the most important newspapers—English, foreign, and colonial—will be filed; where the maps, charts, engravings, books, and transactions of learned societies, can be conveniently consulted; and where the latest information bearing upon geographical discoveries, and all matters especially relating to new shoals, rocks, and harbours, will be regularly exhibited. In the extension of the present plan within the proposed buildings, ample space will enable the Institute to fill up a great public want—viz., an immediate public reference to all the Government publications, the Admiralty Charts, the Colonial Surveys, the Parliamentary Maps, and maps published throughout the world; thus combining with the highest aims of science, and the most profound researches, the means of diffusing information and instruction to the humblest inquirer.

Our business lies not in dictating the mode by which all these things may be effected; for that we refer our readers to the prospectus issued by the society.

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PUBLIC EDUCATION IN THE UNITED STATES.

THE general features of public education in the United States of America have been already noticed. But as the subject is deserving of the deepest consideration of our own countrymen, we do not hesitate to resume it.

With the American Government the education of the masses is considered as of the most vital importance; and it is nationally promoted with a view of rendering the rising generation more intelligent, virtuous, and patriotic.

The following synoptical review of the general features of the American system of public education is chiefly gleaned from Siljestrom's recently published work on the subject.

It appears that each of the townships or towns, into which the States are divided for administrative purposes, has the right to divide itself into two or more school districts. Each township, however small it may be, is bound to maintain at least *one* school, in which instruction is imparted during *six* months of the year. Every township comprising 100 families is bound to maintain *one* school *throughout* the year. Every township comprising 150 families must maintain *two* schools during *nine* months of the year. Every township comprising 500 families must maintain *two* schools *throughout* the year. In these schools are taught reading, writing, arithmetic, English grammar, geography, and the common principles of morality. Each township comprising 500 families must also maintain a school in which, besides this elementary instruction, the pupils shall be taught the history of the United States, geometry, algebra, land-surveying, and book-keeping; and this school must be in activity at least *nine* months in the year. These schools are denominated *English high schools.*

Townships comprising a population of 400 souls must further maintain a school in which instruction shall be given in Greek and Latin, general history, logic, and rhetoric, besides all the branches taught in the other schools. Such schools are called *Latin high schools.* All these schools are open to every child in the community without distinction, who has reached the requisite age and attainments, the high schools being in common for the whole township, but the district schools restricted to the respective districts.

As a general rule, the instruction in these schools is entirely gratuitous. There are few exceptions to the rule, and those are fast disappearing. The American system is essentially a system of *free schools;* and public opinion appears to be very decided as regards the merits of this feature.

The amount to be levied in each township for *teachers' salaries* and for *fuel* is determined at a yearly meeting of all the voters, the qualifications for voting being the same as those required in all local and political questions. If the township be divided into two districts, the sum levied is distributed among these at the same meeting. But the law does not determine any proportion to be observed in the distribution, and accordingly no general basis exists for this purpose. If a township be not subdivided into districts, it has further to tax itself for the erection and furnishing of as many school-houses as may be required.

The general executive power of every township is vested in the so-called *select men,* who are elected annually from among the rate-payers. The actual superintendence of the schools, however, is entrusted to a *school committee,* which is likewise elected annually. Each member of the school committee receives a fee of at least one dollar for each day devoted to the business of the schools. By the side of this committee is placed another for each district, called *the prudential committee,* and consisting of members residing within the district. This committee represents the executive power of the district in school matters, and the inhabitants are responsible for its proceedings. The prudential committee is more particularly charged with the care of the mechanical arrangements and general expenditure of the district schools; whereas the school committee, besides attending to the same matters as regards the town schools, is further intrusted with the superintendence and inspection of the intellectual and moral departments in all the schools.

The Boards of Education consist, for the most part, of ten members, among whom, *ex officio,* are the governor and deputy-governor. The eight other members are appointed by the governor and the council for eight years, one member retiring each year, and being replaced by another. The members of the boards receive no salary, but are indemnified for any expenses they may incur in the service. The secretary, on whom the greatest amount of business devolves, receives a stated salary (in Massachusetts 1000 dollars a year), besides compensation for all expenses incurred in the service.

The functions of the boards consist 1st, in superintending the normal schools; 2nd, in collecting and diffusing information; 3rd, in giving advice and encouragement. The secretary makes each year extensive tours of inspection, and endeavours, by means of lectures and addresses to the people, as well as to the authorities, to keep alive a general interest in the school system. He is bound to keep in his office a collection of all books, maps, and other materials of instruction, which can be obtained gratuitously, for consultation by teachers and school authorities.

"There is a fearful spirit busy now;
  Already have the elements unfurled
  Their banners; the great sea-wave is upcurled:
The cloud comes; the fierce winds begin to blow
About, and blindly on their errands go;
  And quickly will the pale-red leaves be hurled
  From their dry boughs, and all the forest world,
Stripped of its pride, be like a desert show.
  I love that moaning music which I hear
  In the bleak gusts of autumn, for the soul
Seems gathering tidings from another sphere,
  And, in sublime mysterious sympathy,
  Man's bounding spirit ebbs and swells on high,
  Accordant to the billow's loftier roll."

BARRY CORNWALL.

THE sun shines brightly, but not on luxuriant fields and flowery meads. The aspect of Nature is changed; for autumn—that

" Season of mists and mellow fruitfulness,
Close bosom-friend of the maturing sun"—

has commenced, and the smiling scenes of summer are replaced by barren fields and falling trees, through which the breezes rush with fitful sounds, stripping the yellow foliage from their tremulous branches. The clouds are driven rapidly through the sky, the sea looks majestic with its white-crested billows, and the breakers bursting on the rocky coast or pebbly strand ; and

> "In countless numbers, from the thatch, or tiles,
> The instinct-guided swallows leave the plain,
> And seek a warmer air in distant isles."

Have you reflected upon the decline of the year ? Have you thought of the past, and provided for the future ? Have you once considered that the surrounding changes of Nature are intended as lessons for yourself ? We fear not; but remember that even

> "As the light leaf, whose fall to ruin bears
> Some trembling insect's little world of cares,
> Descends in silence, while around waves on
> The mighty forest, reckless what is gone !
> Such is man's doom, and ere an hour be flown
> Reflect, thou trifler, such may be thine own ?"

October is the tenth month of the year, although its name is derived from *octo,* eight, and *imber,* a shower of rain. In the time of Romulus, the number of its days was, as at present, thirty-one; but Numa Pompilius reduced the number to twenty-nine ; and Julius and Augustus Cæsar each added one day; so that its original number of days was restored, and has not been altered since.

Our Saxon ancestors called the month *Wyn-monat,* or wine month, *wyn* signifying wine ; and Verstegan remarks :—"Albeit they had not anciently wines made in Germany, yet in this season had they them from divers countries adjoining." They also called it *Winter fulleth or fylleth,* from the approach of winter.

The synonymes of the month are—in Latin, *October ;* in French, *Octobre ;* in Italian, *Ottobre;* and in Portuguese, *Outubro.*

This month was allegorically represented as a young man dressed in a garment of carnation and yellow, indicative of the hue of the trees at this season ; his head was decorated with a garland of acorn and oak leaves, and his face was

> "Full of merry glee,
> For yet his noule was totty of the must,
> Which he was treading, in the wine-fat's lee,
> And of the joyous oyle, whose gentle gust
> Made him so frollick."

In his right hand he held a basket of medlars, chestnuts, mushrooms, and other fruits, "ripe and rare ;" while in his left hand he grasped the sign *Scorpio,*—the scorpion, symbolical of the sun entering that constellation on the 23d of the month.

The chronology of the month, replete with interesting records of past events, is given below.

CALENDAR FOR THE MONTH.

1. Pheasant shooting begins.—*Remigius.*
2. Dr. Channing died 1842.
3. *Old St. Matthew.*—Archbishop Tillotson born 1730.
4. Bishop Heber died 1833.
5. Oppenheim born 1799.—Battle of Cadiz 1804.
6. *Faith.*—Withering died 1799.
7. Archbishop Laud born 1573.—Dr. Zimmerman died 1795.
8. Lord Erskine died 1817.
9. *St. Denys.*—Eddystone light-house finished 1759.
10. H. Cavendish born 1731.—Benjamin West born 1738.
11. *Old Michaelmas Day.*—America discovered 1492.
12. Stoll born 1742.
13. Canova died 1822.
14. Tycho Brahe died 1601.—W. Penn born 1644.
15. Ridley burnt 1555.—Vesalius died 1564.
16. Battle of Leipsic 1813.—Houses of Parliament burnt 1834.
17. *St. Etheldreda.*—Sir P. Sydney died 1506.
18. *St. Luke.*—Dr. Manton died 1677.
19. Sir G. Kneller died 1723.—Dean Swift d. 1745.
20. Sir C. Wren born 1632.
21. Battle of Trafalgar, Lord Nelson killed 1805.
22. Sir Cloudesley Shovel wrecked 1707.
23. Royal Exchange founded 1667.—F. Simon died 1843.
24. Leeuwenhoek born 1632.—Edict of Nantes revoked 1685.
25. *St. Crispin.*—Battle of Agincourt 1415.
26. Hogarth died 1764.—Dr. Doddridge d. 1751.
27. Captain J. Cook born 1728.—D'Alembert died 1783.
28. *St. Simon and St. Jude.*—Alfred the Great died 900.
29. Sir W. Raleigh beheaded 1618.—R. B. Sheridan born 1751.
30. Tower armoury burnt 1841.
31. *All Hallow Even.*—John Evelyn born 1620.

The Red Letter Days of the month are as follow :—

1*st.*—"*Remigius*" was the archbishop of Rheims, and the tutor of Clovis, the first king of the Franks who professed Christianity, and who was baptized by Remigius. The accession of Clovis to the church is deemed to have been the origin of the "*most Christian King,*" and the "*eldest son of the Church,*" which the kings of France are styled.

3*rd.*—"*Old St. Matthew.*"—The festival of St. Matthew was anciently held upon this day.[*]

6*th.*—"*Faith.*"—This name, in the Church of England calendar, was given in honour of a female of Aquitain, who was put to death under Dacian. She was the titular saint of several churches in France, particularly that of Longueville in Normandy, which was erected by Walter Giffard, Earl of Buckingham.

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[*] For an account of this festival, see p. 121, vol. vi.—21st of September.

9th.—"*St. Denys or Denis,*" is the patron saint of France, and the legend informs us, that he was beheaded, with some other martyrs, in the year 272, upon an eminence in the neighbourhood of Paris, since called *Mons Martyrum* (*Montmartre*), in honour of them. It is related, that no sooner was his head separated, than

> "The breathless body finds both feet and way,
> He takes his head in hand, and forward goes,
> Till the directing angels bid him stay."

Having travelled in this manner for about two miles, he met with a woman, into whose hands he put his head; but what became of the worthy saint's body, after he had deposited his head, we are not informed, although Baronius tells us that his body was shown at Ratisbonne, in Germany, minus the little finger of the right hand.

11*th.*—"*Old Michaelmas Day.*"—A custom formerly prevailed in Hertfordshire for young men to assemble in the fields, and choose a leader, whom they were obliged to follow through fields and ditches. This occurred every seven years, and every publican then supplied a gallon of ale and a *ganging cake*—a plum cake—so called from the day being termed a ganging-day. Every person they met in their peregrinations was taken up by the arms and bumped; or if two were captured, they were swung against each other, unless they paid a small fine to the leader. This is said to have been the origin of the game called "Follow my leader," which is played by most schoolboys.

17*th.*—"*St. Etheldreda*" was the daughter of Annas, King of the East Angles, and born about 630, at Ixning, formerly a noted town on the western border of Suffolk. Having taken the veil, she ultimately became an abbess, and acquired celebrity for having saved herself and nuns from the outrage of the Danes, by mutilating their faces, which so exasperated the Danes, that they fired the convent, and destroyed its inmates. She is styled, in the Roman brevaries, "twice a widow, and always a virgin," because she was forced by her parents to marry twice; but nevertheless she managed to keep her vow to remain a nun.

18*th.*—"*St. Luke.*"—This festival was appointed in the twelfth century, in honour of the Evangelist. He is said to have died about the year 70, at the age of 84, having written his gospel when 76 years of age.

25*th.* — "*St. Crispin.*"—Formerly St. Crispinian's name was coupled with St. Crispin's; but it has long been disjoined from it. These two saints are said to have been two Roman youths of good birth, brothers, who, in the third century, went as Christian missionaries to France, and preached for a long time at Soissons. In imitation of St. Paul they supported themselves by working at the trade of a shoemaker by night, while they preached during the day. They were successful in converting the people to Christianity, until arrested by Ricitus Varius, governor under the Emperor Maximiam Herculeus. By his order they were tormented, but bore the cruelties practised upon them with fortitude and patience, and finally perished by the sword about the year 287. They were afterwards canonized, a splendid church built in honour of them at Soissons, in the sixth century, and selected as the patron saints of shoemakers. Some have asserted that St. Crispin was a royal personage: hence in Scotland the shoemaker's frequently assume a leather knife, surmounted by a crown, as their arms, and style themselves "the royal craft."

28*th.* — "*St. Simon and St. Jude,*" is a festival of the English Church. Simon, usually surnamed the Canaanite, retained with the other Apostles, till after the Pentecost. He is said to have suffered martyrdom in Britain. St. Jude, also called Thaddeus, suffered martyrdom in Persia.

31*st.*—"*All-hallow Even,*" or "*Hallow E'en,*" is the great festival of the month, and is the vigil of All-Saint's Day. Many curious customs are connected with this day, some of which we shall notice. Burns informs us, in a note to his poem on "Hallow E'en," that the first ceremony of Hallow E'en is pulling each a *stock* or plant of kail. They must go out, hand in hand, with eyes shut, and pull the first they meet with; its being big or little, straight or crooked, is prophetic of the size and shape of the grand object of all their spells—the husband or wife. If any *yird,* or earth, stick to the root, that is *tocher*, or fortune: and the taste of the *custoc*, that is, the heart of the stem, is indicative of the natural temper and disposition. Lastly, the stems, or, to give them their ordinary appellation, the *runts*, are placed somewhere above the head of the door; and the Christian names of the people, whom chance brings into the house, are, according to the priority of placing the *runts*, the names in question." The young Welsh people of both sexes search for an even-leaved sprig of ash; and whoever is lucky enough to find such a sprig first, says "Cymder," and the person of the opposite party who is equally lucky, answer in like manner. Of course, if the charm succeeds, these two parties are to be married; but if it fails, they remain as before.

Burning nuts is another favourite charm used upon Hallow E'en, which Burns describes as follows:—"They name the lad and lass to each particular nut as they lay them in the fire; and accordingly as they burn quietly together, or start from beside one another, the course and issue of the courtship will be." It has been remarked, by a writer upon the customs of All-hallow Eve, that—

"Those glowing nuts are emblems true
Of what in human life we view;
The ill-matched couple fret and fume,
And thus in strife themselves consume.
Or from each other wildly start,
And with a noise for ever part."

Among the other sports of Hallow E'en we may enumerate—diving for apples in a tub of water; bite apple, which consists in biting at an apple affixed to one end of a stick, which has a lighted candle at the extremity; eating an apple at the looking-glass; sowing hemp-seed; running round the bean-stalk three times; dipping in the dishes; lighting bonfires; and ringing the bells for all Christians souls.

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HISTORICAL REVIEW OF THE ENGLISH LANGUAGE.*

"Words are the sole expounders of the mind,
And correspondence keep 'twixt all mankind."

The first Anglo-Saxon writer of eminence, who wrote in his own language, and of whom there are any remains, was Cædmon, a monk of Whitby, who died about A.D. 680. The following is a specimen of Anglo-Saxon poetry in that day; it was composed by Cædmon on the "Work of Creation," and is selected, as will be other specimens of Anglo-Saxon and early English, from Chambers' "Cyclopædia of English Literature":—

Anglo-Saxon.—"Nu we sceolan herian—heofon-rices weard, metodes mihte and his mod-ge-thonc wera wuldor fæder! swa he wundra ge-hwæs ece dryhten oord onstealde."

Translation.—Now we shall praise the guardian of heaven, the might of the Creator, and his counsel, the glory father of men! how he of all wonders, the eternal Lord, formed the beginning.

A few names of inferior note fill up the list of Anglo-Saxon variety to the time of the venerable Bede. His works were very numerous, and consisted chiefly of Scriptural translations, commentaries, religious treatises, and the most useful of all, an ecclesiastical history of the Anglo-Saxons. Some of his works were subsequently translated into the venacular by the illustrious Alfred, who designed thereby to improve the condition of his ignorant subjects. Alfred was born A.D. 848, and died A.D. 901.

The following specimen of Anglo-Saxon, as it existed in the interval of these dates, is an extract from his translation of Boethius "On the Consolation of Philosophy," and is selected from Spalding's "History of English Literature:"—

"We sculon get, of ealdum leasum spellum, the sum bispell reccan. Hit gelamp gió, thætte án hearpere wæs on thæse theode the Thracia hátte. Thæs náma wæs Orfeus. He hæfde án swithe ænlic wif. Sió wæs háten Eurydice."

Transl.—We will now, from old lying tales, to thee a certain parable tell. It happened formerly, that a harper was in the nation which Thrace was called. His name was Orpheus. He had a very incomparable wife. She was called Eurydice.

Subsequently to Alfred, the next important name is that of Ælfric, Archbishop of Canterbury, who died A.D. 1006. He, like Alfred, wrote much in the vernacular for the enlightenment of the people. The following specimen of Anglo-Saxon prose, in his day, is a selection from his "Paschal Homily":—

"Hæthen cild bith ge-fullod, ac hit ne bræt na his hiw with-utan, dheah dhe hit beo withinnan awend. Hit bith ge-broht synfull dhurh Adames forgægednysse to tham fant fate. Ac hit bith athwogen fram eallum synnum with-innan, dheah dhe hit withutan his hiw ne awende."

Transl.—A heathen child is christened, yet he altereth not his shape without, though he be within changed. He is brought sinful through Adam's disobedience to the font vessel. But he is washed from all sins inwardly, though he outwardly his shape not change.

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* Continued from page 141.

We have now arrived at that stage—the semi-Saxon period of the language—at which the vernacular Anglo-Saxon *first* began to pass into modern English. There exists a production, usually known by the name of the Anglo-Saxon Chronicle, which gives a view of early English history, and is supposed to have been composed by a series of authors, commencing soon after the death of Alfred, and continuing to the reign of Henry II. The following passage, therefore, gives a frightful description of the miseries endured by the peasantry during the disturbed reign of Stephen, and must therefore have been written subsequently to that king's death, which took place A.D. 1154 :—

> "Hi swencten the wrecce men of the land mid castel-weorces. Thá the castles waren maked, thá fylden hi mid yvele men."
>
> *Transl.*—They oppressed the wretched men of the land with castle works. When the castles were made, then filled they (them) with evil men.

The Norman Conquest produced a great change in the language of the country. Norman-French, a modification of Latin which arose in the middle ages, became the language of education, of the law courts, and of the upper classes generally. But it was destined, in the course of the 12th century, to undergo great grammatical changes. Its sounds were greatly altered, syllables were cut short in the pronunciation, and the terminations and inflections of words were softened down until they were entirely lost. Dr. Johnson says that in this manner the Normans affected the Anglo-Saxon more than by the introduction of new words; and this opinion is supported by the evidence supplied by Lazamon's metrical chronicle, the "Brut," which belongs to the end of the twelfth century, or the beginning of the thirteenth, and must, therefore, have been written a century and a half after the Norman Conquest, and which, notwithstanding that it contains more than 32,000 lines, has few words not Anglo-Saxon, and only about fifty which may be regarded as French.

The following is an extract, from a charter of Henry III., in the common language of the time :—

> "Henry, thurg Godes fultome, king on Englelaunde, Lhoaverd on Yrloand, Duk on Norman, on Acquitain, Earl on Anjou, send I greeting to alle hise holde, ilærde and illwelde, on Huntindonnschiere."
>
> *Translation.*—Henry, through God's support, King of England, Lord of Ireland, Duke of Normandy, of Acquitain, Earl of Anjou, sends greeting to all his subjects, learned and unlearned, of Huntingdonshire.

The following specimen of old English belongs to the middle of the fourteenth century, and from it will at once be seen the rapid change the language had then undergone, so much so, that it can be ventured without a translation; it is taken from "The Vision of Pierce Ploughman," a poem ascribed to a priest of that day, and written evidently for the purpose of exposing the corruptions of the church, the cause which even then was silently preparing the way for the Reformation. Pierce is represented as falling asleep, and seeing a series of visions :—

"Out of the west coast, a wench, as we thought,
Came waeking in the way, to hell-ward she looked;
Mercy hight that maid, a meek thing withal,
A full benign burd, and buxom of speech;
Her sister, as it seemed, came soothly waeking,
Even out of the East, and westward she looked,
A full comely creature, truth she hight,
For the virtue that her followed afeard was she never.
When these maidens mette, Mercy and Truth,
Either axed other of this great wonder,
Of the din and of the darkness," &c.*

With these imperfect models as his only native guide, arose our first great author, Geoffrey Chaucer, distinctively known as the father of English poetry. Though our language had risen into importance with the rise of the Commons in the time of Edward I., the French long kept possession of the court and higher circles; and it required a genius like that of Chaucer to give literary permanence and consistency to the language and poetry of England. Henceforward his native style, which Spenser terms "The pure well of English undefiled," formed a standard of composition. It is unnecessary to continue specimens of the English language for the purpose of exhibiting the transitions thereof from one stage to another, farther down than the time of Chaucer and Wycliffe. The language they composed in has been called middle English, and is, in all essentials, so like our everyday speech, that there scarcely exists any difficulty, except probably the old-fashioned spelling, to prevent any well-informed Englishman of the present day from readily understanding every word of it.

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* Chambers's "Cyclopædia of English Literature."

The following selection is from Chaucer's "Canterbury Tales"—

> "A knight there was, and that a worthy man,
> That fro the time that he first began
> To riden out, he loved chevalrie,
> Trouthe and honour, freedom and curtesie.
> Ful worthy was he in his lordes werre;
> And, therto, hadde he ridden, none more ferre,
> As wel in Cristendom as in Hethenesse,
> And ever honoured for his worthinesse."

The name of Wicliffe must ever be considered one of the greatest in English history. In maintaining the great doctrines of the Reformation, and defending himself against priestly intolerance and persecution, he produced many controversial works of great merit; but the work of the most enduring utility was his translation of the Holy Scriptures into the vernacular. The following, a translation of the "Magnificat," may be taken as a fair specimen of his style—

> "And Marye sayde, my soul magnifieth the Lord,
> And my spiryt hath gladid in God myn helthe. For he hath behulden the mekenesse of his handmayden; for lo, for this alle generations schulen seye that I am blessid. For he that is mighti hath don to me grete thingis, and his name is holy. And his mercyis fro kyndrede into kyndredis, to men that dreden him. He hath made myght in his arm, he scatteride proude men with the thoughte of his herte."

The comparative number of words in modern English derived from the mother tongue, and the method whereby such number has been tested, have been previously stated. It is not sufficient, however, for a thorough appreciation of the importance comparatively of the elements of our language, that we should know how many words therein are traceable to the Anglo-Saxon, and how many to a foreign original. The mere question of the number of words so derived has in it more of the curious than the useful; and, when so put, may have the effect rather of deceiving us as to the proper value to be attached to the respective elements. Words which may be very numerous in dictionaries, may be comparatively unimportant as being wholly unnecessary to the conducting of correspondence, and carrying on the ordinary business of every day life, whilst words, on the contrary, or sorts of words that occur less frequently, may be of such importance as to render it impossible to dispense with them. The vocabulary of the English language being analysed in this way, the obligations it is under to the Anglo-Saxon will appear in a much stronger light than by analysing it merely in reference to the number of words deduced from the latter. The following are the classes of words in modern English, derived from an Anglo-Saxon parentage.

1st. Words which imply relationships. The importance and necessary number of such words will be seen by a careful perusal of Locke's "Essay on the Human Understanding," Book ii., chapters 25, 28 inclusive.

2nd. We owe to the Anglo-Saxon not only the great body of our adjectives, implying as they do, evident relationships, as great, small, big, &c., but the nouns and verbs, which are usually denominated by grammarians irregular.

3rd. We derive from the mother tongue the names for the greater number of objects perceived by the senses, as sun, moon, stars, land, water, wood, stream, hill, and dale; to which may be added names for the most common animals and plants.

4th. Whilst from Latin, and in many instances, French, we borrow such particular words as imply an abstraction, and are very general in their applications, those whose signification are particular, we generally borrow from the Saxon. We materialise a Latin word for instance, when we speak of "colour," but fall back on our mother tongue when we specify the particular sort, and describe it as red, yellow, blue, white, black, green, brown, &c. &c. In the same manner, we Romanise the expression when we speak of "motion" in general, but are obliged to fall back again on the Teutonic element when we specify the sort, and say—He, leap, spring, stagger, slip, slide, glide, fall, walk, run, swim, ride, creep, crawl, fly, &c. &c.

5th. From the same origin we derive the great bulk of such expressions as are used to denote ordinary kinds of feeling and affection—to name the individuals who are the earliest and most natural objects of our attachment, and those inanimate things by which we figuratively signify domestic union and habits. Of this class are the words—love, hate, hope, fear, gladness, sorrow, smile, tear, sigh, groan, weeping, laughter, father, mother, man, wife, child, son, daughter, kindred, friends, home, hearth, roof, fireside, &c. &c. These are instances of a multitude of words, which, even when they are not the only names for the things called by them, are the first we learn to give them ; they therefore occur to us most readily, and have the power, through the association of ideas, of recalling to our minds, when we are so disposed, a great variety of the most affecting sensations, images, and emotions.

6th. The Anglo-Saxon element of modern English is that which supplies us with the language of ordinary business transactions —the counting-house, the shop, the market, the street, the farm;—and of invective, humour, satire, and colloquial pleasantry; and thus becomes, among the eminently practical people, the medium of practical action.

The organization of the English language may be regarded as complete at the beginning of the sixteenth century. The rules regulating the changes to be made on words, and determining the grammatical structure of sentences, had been definitively fixed previous to that period. The mere vocabulary of the language, however, had not been so fixed. Indeed the vocabulary of the language may not be said even to be finally fixed, as it continually receives new accessions, especially in the case of modern languages, from the necessities for fresh words arising from the numerous discoveries in science and other causes. During the last three centuries, therefore, our language has been considerably enlarged as it regards the number of words, especially such words as have been introduced by classical scholars from a classical stock; otherwise it has undergone no change since the end of the middle ages, except changes in style; that is, varieties in the manner in which individuals, all using the same language, express their ideas.

Such is a brief sketch of the history of our native language, that language which has been made use of to awaken in the hearts of Englishmen love, hope, patriotism, and a boundless, innumerable store of the pleasantest associations. It combines strength, precision, and copiousness sufficient to enable it to be the efficient medium of communication between millions: and these, that part of the human race that appears most likely to control, in an eminent degree, the future destinies of the globe. It is calculated, that before the end of the present century English will be the native and vernacular language of no less than 150 millions of human beings; and, from the restless energy and colonising spirit of those who speak it, will yet be written down, in the page of history, as one of the greatest engines for the dissemination of civilisation and christianity throughout the remotest corners of the globe.

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INDUSTRIAL SCHOOLS.

> " Our remedies oft in ourselves do lie
> Which we ascribe to Heaven."—*Shaks.*

Of late, industrial education has engaged the earnest attention of many of the leading spirits of the age. As the subject is deeply interesting to those to whom the Family Tutor is specially addressed, we purpose devoting some space to its consideration.

By the term *Industrial Schools*, we mean all places to be set apart for the eliciting or enlarging the powers and capacities of the pupils, so that they may engage in any of the industrial arts—from cobbling shoes to constructing railroads, from bricklaying to sculpture, from darning stockings to the finest workings of the loom.

Now this industrial teaching has hitherto, from several causes, been left almost entirely unprovided for by any general or methodized system. Every one who has taken up the practice of any art, whether he has gone apprentice to a shoemaker, a glazier, or a stone-mason, or has entered the workshop of a manufacturer, or the office of a civil-engineer, has had to depend, for instruction in his art, solely on the teaching of his individual master, or on that of his journeymen and assistants. It has heretofore been impossible for any youth to acquire any preliminary instruction specially adapting him to take up the practice of any art or manufacture, or even to acquire so much preliminary knowledge, or insight into its nature, as to know whether he should like it, or to judge whether he was fit for it; so that, to use the words of a popular journalist, "it is a chapter of accidents that the right man gets to the right position." Nor is this all; for still less possible has it been for any one to acquire such an amount of instruction in the theory and science of his art, and in those branches of knowledge which are kindred and allied to it, as should be hereafter usefully brought to bear, either in acquiring practical skill, or in extending or simplifying practical processes.

According to the present system, in the practical education of children not intended for the learned professions, from five or six to fourteen is assumed to be the proper period for their acquisition of book-knowledge, and from fourteen to twenty-one to be the period in which they are to learn trades. The eldest boy is usually compelled to pursue his father's trade. In most poor families all the boys follow the same trade, because there is no apprentice-fee to pay. At twenty-one there are many, more marred than made, passing through a baffling process of trying to fit themselves to a position for which they are unfitted by nature; and hence arises what has been called the "battle of life."

"Man is a sodger, and life is a faught."

It is the want of the facility for seeing the round of arts that causes people to take to those they are totally unfitted; thus, among other serious consequences, materially diminishing the total amount of production. What a different man—physically, morally, and intellectually—would John Smith, the tailor, have been, if circumstances had allowed him to have followed the bent of his inclination, in becoming a wheelwright! Thomas Brown, the bricklayer, now an idler and a drone, detesting the trowel, would probably have made a gardener worthy of Chatsworth!

If Industrial Schools should be established, this great evil—the ruin of men, by placing them in false positions—would be provided against.

One circumstance has, we have no doubt, had influence in hindering, or rather delaying, the establishment of industrial schools—the almost universal prejudice existing among the working-classes against the *theories* of purely scientific men. This, of course, has arisen from ignorance of the real value of the man of science. Dr. Lyon Playfair gives us, in his *Lecture on the National Importance of Studying Abstract Science, with a View to the Healthful Progress of Industry,* some instances of the fallacy of the notion, that men of abstract science are of no avail in the practical pursuits of life. He says:—

"But show him a young officer of artillery, looking through a prism at the windows of the Luxembourg, and noticing that in a particular position the light of these windows disappeared from his view. Show him, farther, the startled wonder with which the philosophers of Europe heard of this phenomenon, and the eagerness with which they threw themselves into the track of an observation apparently so insignificant—and your utilitarian sneers at science and its followers, and buries himself again in the darkness of his empiricism. The light reflected from the windows of the Luxembourg had suffered a change similar to that experienced by ordinary light in passing through doubly refracting Iceland spars. When a ray of this changed or *polarised* light is passed through plates of crystallised substances, brilliant colours and a peculiar structure are observed. These remarkable phenomena are indeed well worthy of the attention of scientific observers. Nothing, however, could appear more remote from practice than the study of an altered beam of light. * * * *

"In a short time, this property of the polarising prism was applied to the important purpose of detecting rocks and shoals at sea. * * * *

"Under the hands of a Biot, a ray of polarised light performed, with magical quickness, the most refined but tedious operations of the analytical chemist, and enabled him to tell the amount of sugar in the cane or beet juice. * * *

"By the same ray of light the size of distant objects may be measured, and even time may record its passage."

In the same lecture Dr. Playfair instances the study of the abstract laws of light, resulting in the unexpected discovery of the daguerreotype and photography. He then goes on to galvanism and electricity:—

"When an Italian physician, having hung on an iron railing the legs of a frog fastened to copper hooks, observed that each gust of wind caused convulsions in the legs of the dead animal, who could have prophesied that this accidental observation would entirely alter the character of a future century?—and yet it is but an application of this discovery, extended, it is true, by many intermediate researches, that annihilates space and time, that empowers our thought to travel with the speed and with the power of lightning to the most distant lands, and enables mind to be reciprocated without being arrested by distance in space. * * * * *

"Electricity now plates with gold and silver the baser metal; copies in metal from more perishable materials the most exquisite designs and forms; perpetuates the skill of the engraver, by multiplying, at a trifling cost, his elaborately-engraved plates; and separates and purifies the metals, formerly only attainable by tedious and complex chemical operations.

"Electricity offers for your lighthouses light of a brilliancy the most intense, and asks you to substitute the light gas which streams through the streets by a still more ethereal existence running along simple wires. Even in the smallest offices of goodwill to man, she refuses not her aid, and offers to tell the perfumer whether his essential oils are adulterated with cheaper fatty substances, as willingly as she lends aid to the chemist in the minute operations of his laboratory practice, or as she kindly ministers with the physician to allay human suffering and restore wasted strength. Recollect that all these are but the beginning of her applications, and that we know not to what extent they may be carried out; and rejoice with me that philosophers studied her abstract laws, from the knowledge of which these applications have arisen."

It is scarcely necessary for us to say to our readers, that they may rest assured that it is next to an impossibility for the most abstruse philosspher to pursue the most abstract scientific study in the deepest seclusion of his closet or laboratory, without frequently becoming the promulgator of some truth or some law or relation which shall be the cause of a vast increase of convenience, comfort, and happiness, to thousands of his fellow men.

We feel ourselves, therefore,—from what we have here shown,—justified in ascribing that it is very desirable to reduce abstract science to practice, and to utilize its results for the purpose of ministering to our household and common wants and necessities.

It is not to be supposed, for a single moment, that every individual would be capable, even if desirous, of comprehending or practising all the varieties of knowledge or art; but we think we have displayed to the reader how desirable it is that schools should exist where the whole round of the useful arts may be brought to bear upon one another. In such establishments the arts would fall under the observation of boys whose initiative faculties would take up and apply them for what they are best adapted, and who would not necessarily confine themselves to one variety, but would take up all that are analogous to each other. Even employments, apparently diametrically opposed, would be sometimes found adapted to the same individual. The boy working in the garden would like to construct his tools in the workshop, and would in many cases make them better and fitter for the different purposes, than the boy not understanding their use.

The word *teach* is commonly used as an essential process in instruction. It is, however, as every schoolmaster well knows, quite certain that all learning, worthy of the name, is a process entirely dependent on the learner, and not on the teacher. The teacher may give a lesson, but it does not therefore follow that the pupil will learn; yet we all know that numerous people acquire, without any teaching whatever, by the simple process of observation and imitation. In learning trades or handicrafts, it is not the master's *word*, but the pupil's *eye* that instructs. A cyclopædia may describe an art most elaborately, and yet not teach it. For this reason it is essential that boys should behold the whole circle of the useful arts; and they will thus acquire those that they are best adapted for almost imperceptibly.

Now, is it better to let this necessary alteration be effected individually and spontaneously, or by concert, and on a systematic plan?

The results obtained in this country, by what has been called the voluntary system of industrial education, are so vast and magnificent, our manufactures and machinery of every description are so great and so excellent, that we do not blame our countrymen for having hesitated in interfering with that system, until such time as good cause could be given for the innovation.

Since the matter has been carefully investigated, however, it would appear most advisable to do so; and for the following reasons:—Our superiority in manufacturing industry may be due to other circumstances than the methods by which the practice and the skill are imparted from one generation to another, or by which the discoveries of abstract science are reduced to practical uses. Our grand natural resources, and our insular position—our political institutions—and the habits of our people, may have given us a *temporary* superiority to the rest of the world in manufacturing skill and productive power. Circumstances may arise, or may have arisen, which may put other nations on a par with with us, and enable them not only to successfully compete with us, but actually to surpass us. Our practical skill may have been produced, not in consequence of the absence of all systematic industrial education, but in spite of that absence. If so, it is clear that it will be highly prudent for us to secure our high position, to increase our skill, and to turn our resources to the best possible advantage, by adding to them a well-devised, systematic, industrial education.

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LESSONS IN FRENCH.

PRONOUNS.

Repetition of Personal Objective Pronouns.—Personal objective pronouns are invariably repeated before each verb by which they are governed, in simple tenses; but in compound tenses they are not; as in—God is the creator of the universe; we ought to fear, serve, and love him. Dieu est le créateur de l'univers; nous devons *le* craindre, *le* servir, et l'adorer. He has so much flattered, praised, and blamed us, that we do not know what to think of him. Il *nous a* tant *flattés, loués*, et *blâmés*, que nous ne savons réellement que penser de lui.

Whenever the second verb is a compound of the first, and expresses the repetition of the same action, the objective pronoun may now be repeated; but that repetition cannot be dispensed with, if the second verb express a different action; as in—I tell it and tell it again; if you do not follow my advice, you will certainly ruin yourself for ever. Je *le dis* et *redis* encore; si vous ne suivez pas mes conseils, vous vous perdrez certainement pour toujours. You will never finish this work; for you do and undo it twenty times a day. Vous ne finirez jamais cet ouvrage; car vous *le faites* et *le défaites* vingt fois par jour.

Of two Objective Pronouns governed by the same Verb in all the Tenses of that Verb, except in the Imperative Mood used Affirmatively.—Whenever a verb governs two personal pronouns, whether it be in the affirmative, negative, or interrogative form, and whatever may be the tense or mood in which that verb is used, except the imperative mood employed affirmatively, these two pronouns are placed before the verb, in the following order:—The pronouns *me, te, se, nous*, and *vous*, are never employed together, and one of them being used, it always comes first; they are never followed either by *lui* or *leur*. *Le, la*, and *les* are never employed together; and if one of them should be used with the verb, it should be placed first, provided none of the five preceding ones are wanted. *Lui* and *leur* are never employed together, and should come first, provided no one of those already mentioned is used with the verb; but they are never properly used with *y*. Finally, *y* always precedes *en*, which is always the last. The following examples will illustrate these rules:—Will you send it, him, her or them, to me? Voulez-vous *me le, me la*, or *me les* envoyer? I will send it, him, her, or them to thee, Je *te le, te la, te les* enverrai. He will remember it, him, her, or them, Il *se le, se la*, or *se les* rappellera. He will send it, him, her, or them to us, Il *nous le, nous la*, or *nous les* enverra. They will send it, him, her, or them to you, Ils *vous le, vous la, vous les* enverront. He compels me to it, Il *m'y* force. I will compel thee to it, Je *t'y* forcerai. He condemns himself to it, Il *s'y* condamne. You compel us to it, Vous *nous y* forcez. I have compelled you to it, Je *vous y* ai forcé. Why do you speak to me of it? Pourquoi *m'en* parlez-vous?

Whenever the pronouns *me, te, se, nous* and *vous*, are to be used with either *to him, to her*, or *to them*, as the objects of the same verb, *me, te, se, nous* or *vous* should be placed before that verb, and *to him, to her*, or *to them* should follow it, expressed by *à lui, à elle, à eux,* or *à elles;* as in—Will you introduce me to him, to her, or to them? Voulez *me* présenter *à lui, à elle, à eux,* or *à elles?* I will introduce thee to him, to her, or to them, Je *te* présenterai *à lui, à elle, à eux, à elles.* He has introduced himself to him, to her, or to them, Il *s'*est présenté *à lui, à elle, à eux, à elles,* &c. *Y* is never used with *lui* and *leur,* because a verb in French cannot have two objects governed by the same preposition, unless they are separated by a conjunction, which, however, would be the case, if *y, lui,* and *leur* should be used together, since they stand for *to it, to him, to her,* and *to them.* This difficulty in the French language will be explained, when speaking of the relation existing between the verb and its objects.

Of two Objective Pronouns employed with the Verb in the Imperative Mood used Affirmatively.—Whenever a verb employed in the imperative mood used affirmatively governs two pronouns, these pronouns are placed after that verb, in the following order:—*Le, la, les,* are always placed first, and *moi* and *toi* are placed after *y,* but *nous* and *vous* precede it, and *en* comes the last; as—Send it, him, her, or them, to him, to her, or to them, Envoyez *le lui, la lui,* or *les lui, le leur, la leur,* or *les leur.* Send it, him, her, or them, to me, or to us, Envoyez *le moi, la moi, les moi,* or *le nous, la nous, les nous.* Compel me to it, and I shall do it, Forcez-*y moi,* et je le ferai. Compel us to it, and we shall do it, Forcez *nous-y,* et nous le ferons. If you have any cheese, give me some (of it), Si vous avez du fromage, donnez *m'en.* Here are some apples; give him, her, or them some (of them), Voici des pommes; donnez-*lui* or *leur en,* &c.

The adverb *there,* expressed in French by *y,* follows the same rule as the pronouns *to it* and *to them* (applied to things), also rendered by *y;* thus we should say—Take me there, Conduisez-y moi. Take us there, Conduisez-*nous y.* Behave well there, Conduis-*y toi* bien, &c. Behave well there, Conduisez-vous y bien, &c.

Although most grammarians agree upon the respective place of the pronouns *moi, toi,* and *y,* usage has now almost admitted that the pronoun or adverb *y* should follow the pronouns of the first and second person singular *moi,* and *toi,* making an elision of *oi,* as follows—Take me there. Conduisez *m'y.* Behave well there. Conduis *t'y* bien. Send him there. Envoyez *l'y.*

Of Adjective Possessive Pronouns.—Grammarians do not agree upon the name to be given to these pronouns; they are called, by some, mere adjectives, while others have preserved the old denomination of pronouns, with the qualification of possessive, as they always denote possession. The pronouns of this denomination are divided into two classes:—1st, Those which are always joined to a noun. 2nd, Those which are never joined to a noun.

Of Adjective Possessive Pronouns always joined to a Noun.—Among this class of pronouns, some refer only to one person, and some to several. Those which refer only to one person, as the possessor, are:—For the first person singular (My), mon, ma, mes. For the second person singular, (Thy), ton, ta, tes. For the third person singular (His, her), son, sa, ses. *Mon, ton,* and *son* are masculine singular. *Ma, ta,* and *sa* are feminine singular. *Mes, tes,* and *ses* are masculine and feminine plural. Those which refer to several persons as possessing a single object are:—For the first person plural (Our), notre, notre. For the second person plural (Your), votre, votre. For the third person plural (Their), leur, leur. *Notre, votre,* and *leur* are masculine and feminine singular. Those referring to several persons possessing several objects, are:—First person (Our), nos. Second person (Your), vos. Third person (Their), leurs. *Nos, vos,* and *leurs* are masculine and feminine plural.

In English, these pronouns agree in number and gender with the possessor; while, in French, they agree with the object possessed, and always precede it; as, My horse, Mon cheval (masculine). Thy horse, Ton cheval (masculine). His *or* her horse, Son cheval (masculine). The pronoun which precedes *horse* remains in the masculine, whatever may be the owner, because *cheval* is masculine. My cow, Ma vache (feminine). Thy cow, Ta vache (feminine). His *or* her cow, Sa vache (feminine). The pronoun which precedes *cow* remains in the feminine, whatever may be the owner, because *vache* is feminine. My horses and cows, Mes chevaux et mes vaches. Thy horses and cows, Tes chevaux et tes vaches. His *or* her horses and cows, Ses chevaux et ses vaches. The pronouns which precede *horses* and *cows* do not vary on account of the gender of these two nouns, as they belong to either. Our horse and cow, Notre cheval et notre vache. Your horse and cow, Votre cheval et votre vache. Their horse and cow, Leur cheval et leur vache. The pronouns *notre, votre,* and *leur,* being masculine and feminine, do not vary before *cheval* and *vache;* but it must be understood, that, although they represent the third person plural, they are used in the singular, because they represent the property of *one* horse or *one* cow, divided among several individuals. But if we wish to speak of several horses and several cows belonging to several individuals, then we have to employ the plural form of these very same pronouns of the third person plural; as, Our horses and cows, Nos chevaux et nos vaches. Your horses and cows, Vos chevaux et vos vaches. Their horses and cows, Leurs chevaux et leurs vaches. These pronouns, *nos, vos,* and *leurs,* being of either gender, do not vary before masculine or feminine nouns.

Of the Pronouns Our, Your, Their, Notre, Votre, Leur, *sometimes used in the Plural, sometimes in the Singular in French, according to the meaning of the sentence.*—Whenever the pronouns *our, your,* and *their* are used in English before plural nouns, it becomes necessary to ascertain whether any idea of plurality is attached to those nouns, whether the idea of plurality having been sufficiently expressed by the nominative of the verb, the nouns are only used in their abstract meaning, or, finally, whether these nouns are ever used in the plural, in French. In the former case, the pronoun and noun should be used in the plural; in the two others they ought to remain in the singular; as in—Our heart experiences the want of love, *Notre cœur* éprouve le besoin d'aimer. Our hearts were struck with a feeling of horror, D'un sentiment d'horreur *nos cœurs* étaient frappés. We risked our lives in attempting to save yours, Nous avons risqué *notre vie* en tâchant de vous sauver. In the first sentence, the noun *heart* is used in an abstract meaning, and does not imply an idea of plurality. In the second, the same noun refers to several persons whose hearts were individually struck with horror. In the third and fourth, the idea of plurality is sufficiently expressed by the nominative of the verb. In the last, the nouns *impatience* and *humanité* are never used in the plural, in French, when employed to express a feeling of impatience or humanity.

Of the Agreement of the Adjective Possessive Pronoun.—The possessive adjective pronoun agrees in French with the thing possessed, and not with the possessor, as in English; that is to say, it is always of the same number and gender as the noun before which it is placed; as in—Your sister is very amiable, but her children are very troublesome, *Votre sœur* est fort aimable, mais *ses enfants* sont insupportables. I like your brother, but I cannot bear his wife, J'aime beaucoup *Votre frère,* mais je ne puis souffrir *sa femme.* What has your daughter done with her book? Que *votre fille* a-t-elle fait de *son livre?* As an exception, whenever an adjective possessive pronoun is placed before a feminine noun beginning with a vowel or an *h* mute, euphony requires that pronoun to be used in the masculine; as in—Her image follows me everywhere, *Son image* (fem.) me suit partout. His humanity is proverbial, *Son humanité* (fem.) est proverbiale.

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NATIONAL EDUCATION IN IRELAND.

The report issued by the Commissioners of National Education in Ireland, for the year 1852, contains some very interesting details. It demonstrates the satisfactory truth that even in Ireland—hitherto proverbial for popular ignorance and social wretchedness,—the general spirit of education is progressing, and gradually diffusing its ameliorating influence throughout the length and breadth of the land. Thus will the gloom of ignorance and bigotry be dissipated before the rising sun of knowledge.

On consulting the report before us, we find that at the conclusion of the year 1852 there were 4875 schools in operation, and 544,604 pupils on the rolls; thus showing an increase of 171 schools and 24,203 pupils. Besides these there were 75 schools, intended for 7475 pupils, not in operation. The total attendance in 1852 gives 111 and a fraction to each school. Grants of books and salaries were made to 264 new schools. The number of applications was 405, but

141 were rejected. The sum of £82,964 was paid in salaries, premiums, and gratuities, to the principal literary teachers and others, showing an increase of £6883 over that of 1851. The scale of salaries in the first and second classes, and in the first division of the third class, have been increased since April 1852. The number of monitors at the end of 1852 was 400, of whom two-thirds were male. The value, at the reduced prices of the books sold to National Schools, in the year 1851 was £5887 15s. 9d.; in 1852 the value was £6467 1s. 5d.; the increase over the preceding year was £579 5s. 8d. The estimated value of the grants of books given as free stock in 1852 was £7944 16s. 5d. The number of grants was 2305; being an average to each school of £3 8s. 11d. The total amount of sales to various societies and schools not connected with the Board was £9101 17s. 8d.; which added to the sales to National Schools make a total amount of sales of £15,568 19s. 1d. The number of pupils on the rolls of our Model Schools in Marlborough Street, upon the 30th of September 1852, was—boys, 599; girls, 480; infants, 400; making a total of 1479. The average daily attendance has at various times in the course of the year 1852 exceeded 1200. Of these, 145 belonged to the Established Church, 1311 were Roman Catholics, 21 Presbyterians, and 2 Jews (infants).

The establishment of National teachers forms a most interesting feature in the report. During the year 1852, 302 teachers were trained at the public expense, and 40 not connected with the National Schools. Of this number 17 were of the Established Church, 43 Presbyterians, 240 Roman Catholics, 2 Dissenters. From the commencement of their proceedings to the end of 1852, the commissioners have trained 3420 teachers.

Model Agricultural Schools is another gratifying feature in Irish education. There are in full operation 26 schools, 1 in partial operation, and 2 in process of construction. The numbers of Agricultural Schools in the several provinces of Ireland, on the 31st December 1852, were—Ulster, 31; Munster, 25; Leinster, 22; Connaught, 14; total, 92. The number of pupils receiving agricultural instruction, in 1852, was 2355; being an increase of 629. The total number of Workhouse Agricultural Schools, on the 31st December 1852, was 23; of which 12 are in Ulster, 7 in Munster, 3 in Leinster, and 1 in Connaught.

The following is a general summary of the three principal religious denominations of the children on the rolls of the National Schools, for six months ending the 31st of March 1852: Ulster—Protestants, 17,773; Catholics, 86,253; Presbyterians, 40,305. Munster—Protestants, 1523; Catholics, 148,849; Presbyterians, 57. Leinster—Protestants, 3337; Catholics, 125,029; Presbyterians, 159. Connaught—Protestants, 2051; Catholics, 64,586; Presbyterians, 97. Total—Protestants, 24,684; Catholics, 424,717; Presbyterians, 40,618; which, with about 3000 undenominated, make 498,018.

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TRAINING AND NORMAL SCHOOLS.

The establishment of Training Colleges or Schools is comparatively a new feature in our national system of education, and we rejoice to perceive the general success attending its operations. Several of them owe their origin, in a great measure, to the encouragement afforded them by the government "Minutes" of 1846, which offered grants on account of those students who might obtain certificates at the yearly examinations conducted by the government inspectors. Each student who succeeds at these examinations secures, for the college to which he owes his training, a grant in aid of its funds corresponding with the class of certificate which he may succeed in obtaining. For the lowest class the allowance to the Normal School is £20; to the middle, £25; and for the first, £30.

The average cost of the maintenance of Training Schools is after the rate of about £55 for each student, and the proportion of this charge, which in coming years will, on the foregoing assumption, be defrayed by Government, is £25 for each student, or *five-elevenths* of the total charge. Thus the prospective resources of the Normal Schools are almost totally relieved of their precarious character.

The government "Minute" of April 1853, which relates to grants for the support of schools in agricultural districts and in unincorporated towns, and especially the Education Bill which is now deferred till the session of 1854, will have the effect of creating a great demand for certificated teachers, and hence of supplying a farther incentive to the effective operation of the existing Training Institutions, as well as of calling others into existence.

Kneller Hall Training School, established in the early part of 1850, supplies teachers for the Schools of Parochial Unions; but at present it has none of the accessories in the way of Model Schools of Industry, in which, as contemplated in the Minutes, the children of some contiguous pauper school might be instructed.

Among the most successful industrial schools under inspection are those in Mr. Norris's district, co. Chester, including Sandbach, Betley, and Lilleshall. Mr. Mitchell reports the success of similar experiments in Norfolk and Cambridge; and Dr. Woodford describes favourably the progress of efforts in the same direction in some of the largest towns of Scotland.

Mr. Adderley's Bill (now deferred till the session of 1854), providing for the management of criminal and destitute children, will have the effect, *inter alia,* of bringing up in habits of industry and self-dependence a class of the juvenile population which the Minutes of 1846 have hitherto failed to reach, notwithstanding the provisions for the encouragement of workshops for the different mechanical trades, in connection with schools.

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EDUCATIONAL AND SCHOLASTIC MATTERS.

COLLEGE OF PRECEPTORS, BLOOMSBURY SQUARE.

A meeting of the Council took place on the 13th of August, when the Rev. Dr. Jacob, Master of the Blue-coat Hospital School, was unanimously re-elected. Among other general business, it was resolved that an appeal by circular be addressed to the profession at large, inviting co-operation in an attempt to obtain from Parliament additional powers, in the matter of compulsory examination of all professional Teachers.

A report was received, announcing the result of examinations, on the "Theory and Practice of Education," of sixteen candidates for school certificates. The examiner (Dr. H. Stein Turrell) there states that he had observed a marked superiority in the amount of information relative to the education possessed by the candidates generally, as compared with former examinations; and he ascribed this improvement to the efforts which had been made by the College to direct the attention of teachers, "not merely to the acquisition of the materials for instruction, but also to the study of the *theory* of their profession, as one of the noblest of sciences, and of its *practice* as the finest of the arts."

The following list of the questions, proposed to candidates at the above examination, may be interesting to our juvenile students, and more especially to scholastic aspirants:—

1. Define Education, Instruction, Method, System, Knowledge, Information. 2. Can Knowledge be imparted? State the reasons of your answer. 3. Arrange, in a tabular form, the daily occupations of a middle-class school of forty pupils, from 9 to 16 years of age;—showing the number of teachers required, and the proportion of time you would allot to each study. 4. Wha subjects do you undertake to teach? 5. What peculiar difficulties do these subjects present, and how would you endeavour to remove them? 6. Point out the chief merits of the books and instruments which you employ in teaching. 7. Do you prefer to teach pupils in classes, or separately? State your reasons. 8. Explain the nature of analytical and of synthetical teaching. Give examples of both. 9. Illustrate the difference between Deductive and Inductive teaching. 10. Describe the course of study which you would desire your pupils to follow in your special subjects. 11. What are your views in reference to Play-ground Duty? 12. How would you cultivate the Moral Faculties? 13. Are you acquainted with any of the systems of instruction adopted on the Continent, or in America? If so, point out their merits and their defects. 14. Explain your views of Physical Education.

CHURCH OF ENGLAND SCHOOLMASTERS' ASSOCIATION.

A very laudable institution, under the above title, has recently been formed, in Surrey,—the head quarters of which are at Reigate,—and we feel great pleasure in recommending it as an example to other localities. Its principal objects are—"The promotion of mutual improvement in the attainment of knowledge, by the formation of a library, the circulation of periodicals, and the occasional delivery of lectures; the cultivation of sentiments of mutual friendship; the consideration and discussion of subjects in relation to the great cause of national education, with the view to improvements therein; the fulfilment of duties; and also as to whatever may affect the individual and social well-being of the schoolmaster himself." It is intended that the members of the scholastic profession form branches of the association at Farnham, Guildford, Kingston, Croydon, Reigate, and other places in the county, to meet quarterly, or oftener, to regulate their own proceedings in connection and in concert with a central committee, who will appoint an annual meeting at some town, supposed, from its central position, to be the most convenient.

THE MELBOURNE ATHENÆUM, NEAR DERBY.

The foundation stone of this noble institution, intended for educational and social purposes, was laid by Lord Palmerston, on the 27th of August last, and his lordship then delivered a speech every way worthy of the occasion, of which we present the following brief abstract:—He described the building about to arise as "destined to be an epitome of the life of man, as well as an exemplar of the civilisation and improvement of the age. It was to contain, in the first place, a provision for infancy, in the form of an infant school; in the next place, a provision for the instruction and amusement of man in his maturer years, in the shape of a mechanics' institute; and lastly, in the form of a savings-bank, a provision for advanced and declining age." His Lordship then took up the three objects of the institution separately. "In former times," he said, "the treatment of infants was far different from that which now prevails. Mothers considered—and in some other countries they still consider—infants as encumbrances impeding their useful exertions; and the infants used to be scolded till they cried, and beaten till they ceased to weep. In some countries, mothers who want to employ themselves in useful labour wrap their infants in swaddling-clothes, and hang them up on a peg, as you would do a hat or a great-coat. Now, our improved civilisation has taught us that we may provide for the care of infants, and at the same time begin to instruct their youthful minds. When, therefore, we establish an infant school, we are not only assisting mothers, by giving them the opportunity of following a more useful occupation, but we are laying a foundation for the good order of the community, of which these infants are hereafter to be members."

Having next exhausted the two other topics furnished by the building, his lordship started a new one. "There is one thing wanting to complete the institutions of your town—I mean a school for the education of girls. There is an excellent boys' school, but there is not yet an establishment of the same nature for girls. Now, it is well known that the education of women is of the greatest importance to society. Men may be indeed the rough stones of which the fabric of society is built; they may form the strength and resisting portion of the fabric; but women are the finer cement without which those rougher ingredients will not find order or consistency, and without which there can be no beauty, no form, no lasting and useful enjoyment. But we all know the important influence which is exerted by women upon the welfare of mankind, whether it be in the capacity of daughters, sisters, wives, or mothers; and therefore, independently of any regard for the fair sex, the most selfish considerations, a single regard for ourselves, a regard for man abstractedly and independently of woman, ought to lead us to endeavour to mould and educate the rising portion of the female community, that they may be as well adapted as possible, by good training and instruction, to perform the various duties of life, in the capacities of daughters, sisters, wives, and mothers; and therefore, although it forms no part of the institution which is now about to be established, I commend to your anxious and earnest consideration the establishment likewise of a girls' school at Melbourne."

SCHOOL AT LONGBURTON, CO. DORSET.

A new school-house has just been completed here through the exertions of the vicar, at a cost of £400. The site for the building was given by the lord of the manor, Mr. Drax, M.P. The design was presented gratuitously by Mr. Henry Barnes, of Dorchester, architect. The hall is calculated to contain 100 children, and there is a residence for a teacher. The builders were Mr. Perrott, of Longburton, and Mr. Guppy, of Sherborne.

AUSTRALIAN UNIVERSITY.

We are happy to learn that the higher branches of education are likely to receive that attention, in the distant colony of Australia, to which they are entitled. The treasures of the mind, as well as the riches of the earth, will thus receive their due share of cultivation. A university of Australia has been recently founded and endowed by the local legislature of Sydney; and a project is now on foot to establish a new college, in connection with the university there, for educating ministers of the English church.

ENGLISH EDUCATION IN INDIA.

On the subject of English education in our Indian territories, some useful information has recently been published by Mr. W. Knighton, formerly Principal of the Normal Schools at Calcutta. Among other things he says that there is a general desire in India for English education, and that this desire is "common to the native of Ceylon and mountaineer of the Himalayas, to the luxurious inhabitant of Bengal, and the more masculine Mahrattan of Poonah." In the Government Colleges and Schools of Bengal, he further observes, "a very excellent *secular* education is given to the students and pupils; that is to say, in so far as any education which ignores and zealously excludes religion can, in any way, be considered as excellent."

THE EDITOR AND HIS CORRESPONDENTS.

The "Family Tutor."—We beg respectfully to inform our correspondents that all communications for the Editor should be addressed to the firm of "Messrs. W. S. Orr & Co., Amen Corner, Paternoster Row:" where the Family Tutor will henceforth be exclusively published.

With the present number we have issued the second sheet of a New Work on "British Plants and Structural Botany." It is intended to form a volume independently of the Family Tutor; and thus a sheet of it will be published, from time to time, with our semi-monthly numbers, without any extra cost. In order to render the work as complete as possible, and present it to the world as a standard authority in Botanical Science, neither literary labour, or expense, or graphic skill will be spared.

Ether. A. T. Fraser.—Ether is prepared in various ways, and from different bodies; but our correspondent has not stated what kind of ether he wishes to obtain. Sulphuric ether, however, is that which has been the longest known to chemists. To prepare this ether sulphuric acid is poured in an equal weight of alcohol in a retort; and after they are thoroughly mixed by gradual agitation, heat is applied through the medium of a sand-bath, a large receiver being adapted to the retort, carefully luted, and kept cool by water. Distillation commences when the temperature is raised to 208°, and a colourless liquid condenses in the receiver. When it amounts to about half the quantity of alcohol that had been employed, the heat is withdrawn. The residual liquid is of a dark brown or black colour. If a fresh portion of alcohol, not more than half of the first quantity, be added to it when it is cold, an additional portion of ether will be procured by a new distillation.

Lightning and Electricity.—Grace Hammond asks "whether it is correct that lightning will neither strike glass nor silk?"—This is a general opinion; and it results from the fact that some substances, such as glass and silk, are incapable of conducting electricity; while others, such as metals, and the human body, readily conduct it; thus it is found that all *electrics* are *non-conductors*, while, on the contrary, *conductors* are *non-electrics*. The permanence of electric bodies suspended in the air by silken threads, proves that the air, as well as silk, is a non-conductor, from which circumstance, bodies surrounded by it, except on one side, and that side being in contact with a non-conductor, are said to be *insulated*. Though there is less danger of glass or silk being struck by lightning than a metallic body, yet there is no substance with which we are acquainted that can be said to be wholly impervious to electricity; nor, on the other hand, is there any body which opposes no resistance to the transmission of electricity.

Music in Schools. Juvenis.—We are decided advocates for the introduction of music into all our schools. Wherever it has been encouraged the most pleasing results have been shown. It promotes good reading and speaking, by disciplining the ear to distinguish sounds; and it also facilitates the cultivation of the finer feelings of our nature. It aids very much in the government of the school, as its exercise gives vent to that restlessness which otherwise would find an *escapement* in boisterous noise and whispering—and thus it often proves a *safety valve*, through which a love of vociferation and activity may pass off in a more harmless and a more pleasing way. "The schoolmaster that cannot sing," says Martin Luther, "I would not look upon." Perhaps this language is too strong; but it is usually more pleasant to look upon a school where the schoolmaster *can* sing.

Sciolist.—Sulphuric acid, or oil of vitriol, is prepared from sulphur, or brimstone, mixed with about one-eighth of its weight of nitrate of potash. The mixture is burnt in a furnace, so contrived that the current of air which supports the combustion conducts the gaseous products into a large leaden chamber, the bottom of which is covered to the depth of a few inches with water. The nitric acid of the nitre, composed of oxygen and azote, is decomposed, yields oxygen to a portion of the sulphurious acid formed by combustion, and converts it into a sulphuric acid.

C.—We should be happy to see a further portion of the article on "The Laws of Design," before commencing with the first paper.

J. H. W.—When our correspondent requests us to "say a few words on the best means for young men to guard against the temptations of English towns," he reminds us of the pseudo-moralist who sought out vice for the purpose of showing how he could resist its temptations. But we think there would have been more purity of mind exhibited by his endeavouring to shun it altogether. So we should advise our correspondent not to seek temptations, but endeavour to avoid them, and not inquire where they may be found.

QUERY.

Sir,—Do you, or any of your correspondents, know anything of an Endowment School at Hoddesdon, called "The Hoddesdon Scientific School?" or can you inform me where I can obtain any information respecting it? It is, I find, a small endowment for only ten scholars; but I am anxious to ascertain on what principles it is conducted.

John West.

Erratum, p. 154, col. 1.—In the centesimal addition of money, for £1 1·60 read £2 1·60.

NATURAL PHILOSOPHY.

Second Division.

CHAPTER XLV.

THE ORGAN OF VISION.

The Three Parts of the Eye—Description of the Eye of Man—Uses of the Accessory Apparatus—Optical Action of the Eye—Short and Long-Sightedness—Spectacles—Erect and Double Vision—Peculiarittes of Vision—Physiological Colours.

Almost all animals possess some mechanism by which they are rendered sensible of the presence of light. In some of the lower orders, perhaps, nothing more than a diffused sensibility exists, without there being any special organ adapted for the purpose. Thus many animalcules are seen to collect, on that side of the liquid in which they live, where the sun is shining, and others avoid the light. But in all the higher tribes of life there is a special mechanism, which depends for its action on optical laws—it is the eye.

This organ essentially consists of three different parts—an optical portion, which is the eye, strictly speaking; a nervous portion, which transmits the impressions gathered by the former to the brain; and an accessory portion, which has the duty of keeping the eye in a proper working state, and defending it from injury.

In man the eye-ball is nearly of a spherical figure, being about an inch in diameter. As seen in front, between the two eyelids, *d c*, Fig. 278, it exhibits a white portion of a porcelain-like aspect, *a a*; a coloured circular part, *b b*, which continually changes in width, called *the iris*; and a central black portion, which is *the pupil.*

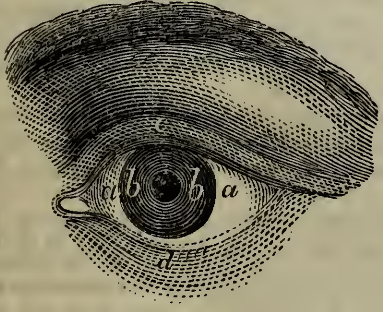

Fig. 278.

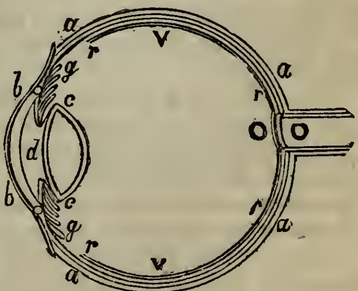

Fig. 279.

When it is removed from the orbit or socket in which it is placed, and dissected, the eye is found to consist of several coats. The white portion seen anteriorly at *a a* extends all round. It is very tough and resisting, and by its mechanical qualities serves to support the more delicate parts within, and also to give insertion for the attachment of certain muscles which roll the eyeball, and direct it to any object. This coat passes under the name of *the sclerotic.* It is represented in Fig. 279, at *a a a a*. In its front there is a circular aperture, into which a transparent portion, *b b*, resembling in shape a watch-glass, is inserted. This is called *the cornea.* It projects somewhat beyond the general curve of the sclerotic, as seen at *b b*, in the figure, and with the sclerotic completes the outer coat of the eye.

The interior surface of the sclerotic is lined with a coat which seems to be almost entirely made up of blood-vessels, little arteries and veins, which, by their internetting, cross one another in every possible direction. It is called *the choroid* coat: it extends like the sclerotic as far as the cornea. Its interior surface is thickly covered with a slimy pigment of a black colour, hence called *pigmentum nigrum.* Over this is laid a very delicate serous sheet, which passes under the name of *Jacob's membrane,* and the *optic nerve,* O O, coming from the brain perforates the sclerotic and choroid coats, and spreads itself out on the interior surface, as *the retina, r r r r.* The optic nerves of the opposite eyes decussate one another on their passage to the brain.

These, therefore, are the coats of which the eye is composed. Let us now examine its internal structure. Behind the cornea, *b b,* there is suspended a circular diaphragm, *e f,* black behind, and of different colours in different individuals in front. This is *the iris.* Its colour is, in some measure, connected with the colour of the hair. The central opening in it, *d,* is *the pupil,* and immediately behind the pupil, suspended by the *ciliary processes, g g,* is the *crystalline lens, c c*—a double convex lens. All the space between the anterior of the lens and the cornea is filled with a watery fluid, which is the *aqueous humour;* that portion which is in front of the iris is called the *anterior chamber,* and that behind it the *posterior.* The rest of the space of the eye, bounded by the crystalline lens in front and the retina all round, is filled with the *vitreous humour,* V V.

With respect to the accessory parts, they consist chiefly of the *eyelids,* which serve to wipe the face of the eye, and protect it from accidents and dust; the *lachrymal apparatus,* which serves to wash it with *tears,* so as to keep it continually brilliant; and the *muscles,* requisite to direct it upon any point.

Of the nervous part of the eye, so far as its functions are concerned, but little is known. The retina receives the impressions of the light, which are conveyed along the optic nerve to the brain.

Now as respects the optical action of the eye, it is obviously nothing more than that of a convex lens, to which, indeed, its structure actually corresponds: and as in the focus of such a convex lens objects form images, so by the conjoint action of the cornea and crystalline, the images of the things to which the eye is directed form at the proper focal distance behind—that is, upon the retina. Distinct vision only takes place when the cornea and the lens have such convexities as to bring the images exactly upon the retina.

In early life it sometimes happens that the curvature of these bodies is too great, and the rays converging too rapidly, form their images before they have reached the posterior part of the eye, giving rise to the defect known as short-sightedness—a defect which may be remedied by putting in front of the cornea a concave glass lens of such concavity as just to compensate for the excess of the convexity of the eye.

In old age, on the contrary, the cornea and the lens become somewhat flattened, and they cannot converge the rays soon enough to form images at the proper distance behind. This long-sightedness may be remedied by putting in front of the cornea a convex lens, so as to help it in its action.

Concave or convex lenses, thus used in front of the eyes, constitute spectacles. It is believed that this application was first made by Roger Bacon, and it unquestionably constitutes one of the most noble contributions which science has ever made to man. It has given sight to millions who would otherwise have been blind.*

The image which is formed by a convex lens being inverted as respects its object, so must the images which form at the bottom of the eye. It has, therefore, been a question among optical writers, why we see objects in their natural position, and also why we do not see double, inasmuch as we have two eyes. Various explanations of these facts have been offered, chiefly founded upon optical principles. None, however, appear to have given general satisfaction, and in reality the true explanation, I believe, will be found not in the optical, but in the nervous part of the visual organs. It is no more remarkable that we see single, having two eyes, than that we hear single, having two ears. It is the simultaneous arrival in the brain, that gives rise out of two impressions to one perception, and accordingly, when we disturb the action of one of the eyes by pressing on it, we at once see double.

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* A defect, and not an uncommon one, exists in the eyes of some persons, which consists in the eyes refracting the rays of light with different powers in different places. The defect may be detected by making a small pin-hole in a card, which is to be moved from close to the eye to an arm's length, while the gaze is directed toward the sky, or some bright object. If the sight be perfect the hole does not alter its circular form at all; but if the peculiar defect exists, the hole becomes elongated, and ultimately merges into a straight line. M. Airey consideres that a spherical cylindrical lens will correct the defect, as it succeeded in his own case.—Ed.

Among the peculiarities of vision it may be mentioned, that for an object to be seen it must be of certain magnitude, and remain on the retina a sufficient length of time; and, for distinct vision, must not be nearer than a certain distance, as eight or ten inches. This distance of distinct vision varies somewhat with different persons. The eye, too, cannot bear too brilliant a light, nor can it distinguish when the rays are too feeble; though it is wonderful to what an extent, in this respect, its powers range. We can read a book by the light of the sun or the moon; yet the one is a quarter of a million times more brilliant than the other. Luminous impressions made on the retina last for a certain space of time, varying from one-third to one-sixth of a second. For this reason, when a stick, with a spark of fire at the end, is turned rapidly round, it gives rise to an apparent circle of light.

By accidental or physiological colours we mean such as are observed for a short time depicted on surfaces, and then vanishing away. Thus if a person looks steadfastly at a sheet of paper strongly iluminated by the sun, and then closes his eyes, he will see a black surface corresponding to the paper. So if a red wafer be put on a sheet of paper in the sun, and the eye suddenly turned on a white wall, a green image of the wafer will be seen. Spectral illusions in the same way often arise—thus, when we awake in the morning, if our eyes are turned at once to a window brightly illuminated, on shutting them again we shall see a visionary picture of every portion of the window, which after a time fades away.

CHAPTER XLVI.

OF OPTICAL INSTRUMENTS.

The Common Camera Obscura—The Portable Camera—The Single Microscope—The Compound Microscope—Chromatic and Spherical Aberration—The Magic Lantern—The Solar Microscope—The Oxyhydrogen Microscope.

In this and the next Chapter I shall describe the more important optical instruments. These, in their external appearence, and also in their principles, differ very much according to the taste or ideas of the artist. The descriptions here given will be limited to such as are of a simple kind.

The Camera Obscura, or dark chamber, originally consisted of nothing more than a double convex lens of a foot or two in focus, fixed in the shutter of a dark room. Opposite the lens and at its focal distance, a white sheet received the images. These represent whatever is in front of the lens, giving a beautiful picture of the stationary and moveable objects in their proper relation of light and shadow, and also in their proper colours.

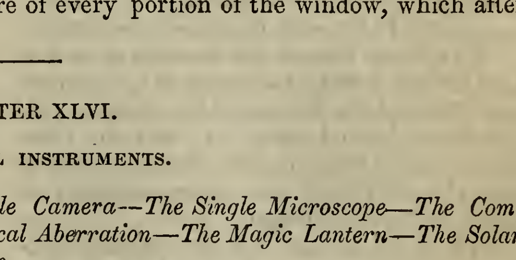

Fig. 280.

In point of fact, a lens is not required: for if, into a dark chamber, C D, Fig. 280, rays are admitted through a small aperture, L, an inverted image will be formed, on a white screen at the back of the chamber, of whatever objects are in front. Thus the object, A B, gives the inverted image, *b a*. These images are, however, dim, owing to the small amount of light which can be admitted through the hole. The use of a double convex lens permits us to have a much larger aperture, and the images are correspondingly brighter.

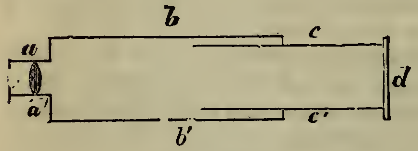

Fig. 281.

The portable camera obscura consists of an achromatic double convex lens, *a a'*, set in a brass mounting in the front of a box consisting of two parts, of which *c c'* slides in the wider one, *b b'*. The total length of the box is adjusted to suit the focal distance of the lens. In the back of the part, *c c'*, there is a square piece of ground glass, *d*, which receives the images of the objects to which the lens is directed, and by sliding the moveable part in or out, the ground-glass can be brought to the precise focus. The interior of the box and brass piece, *a a'*, is blackened all over to extinguish any stray light.

The images of the camera are, of course, inverted; but they can be seen in their proper position by receiving them on a looking-glass, placed so as to reflect them upward to the eye. Objects that are near, compared with objects that are distant, require the back of the box to be drawn out, because the foci are farther off. Moreover, those that are near the edges are indistinct, while the central ones are sharp and perfect. This arises from the circumstance that the edges of the ground-glass are farther from the lens than the central portion, and therefore out of focus.

OF MICROSCOPES.

The single Microscope.—When a convex lens is placed between the eye and an object situated a little nearer than its focal distance, a magnified and erect image will be seen.

The single microscope consists of such a lens, *m*, Fig. 282, the object, *b c*, being on one side, and the eye, *a*, at the other, a magnified and erect image, B C, is seen. The linear magnifying power of such a lens is found by dividing the distance of distinct vision by its focal length.

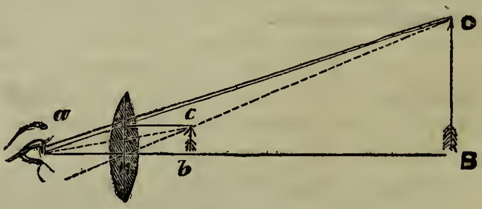

Fig. 282.

The compound microscope commonly consists of three lenses, A B, E F, C D, Fig. 283, A B being the object-glass, E F the field-glass, and C D the eye-glass. Beyond the object-glass is placed the object, at a distance somewhat greater than the focal length; a magnified image is, therefore, produced, and this being viewed by the eye-glass is still further magnified, and, of course, seen in an inverted position. The use of the field-glass is to intercept the extreme pencils of light, *n m*, coming from the object-glass, which would otherwise not have fallen on the eye-lens. It therefore increases the field of view, and hence its name.

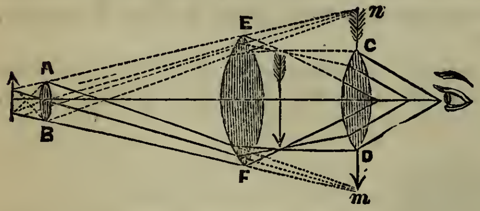

Fig. 283.

In this instrument the object-glass has a very short focus; the eye-glass, one that is much larger; and the field-glass and the eye-glass can be so arranged as to neutralise chromatic aberration.

To determine directly the magnifying power of this instrument, an object, the length of which is known, is placed before it. Then one eye being applied to the instrument, with the other we look at a pair of compasses, the points of which are to be opened, until they subtend a space equal to that under which the object appears. This space, being divided by the known length of the object, gives the magnifying power.

In Fig. 284, we have a representation of the compound microscope, as commonly made. A B is a sliding brass tube, which bears the eye-glass; *m n* is the object glass; I K the field-glass; S T a stage for carrying the objects. It can be moved to the proper focal distance by means of a pinion. At V there is a mirror which reflects the light of a lamp or the sky upward, to illuminate the object. The body of the microscope is supported on the pillar M, and it can be turned into the horizontal or any oblique position to suit the observer, by a joint N. To the better kind of instruments micrometers are attached, for the purpose of determining the dimensions of objects. These are sometimes nothing more than a piece of glass, on which fine lines have been drawn with a diamond, forming divisions the value of which is known. Such a plate may be placed either immediately beneath the object or at the diaphragm, which is between the two lenses.

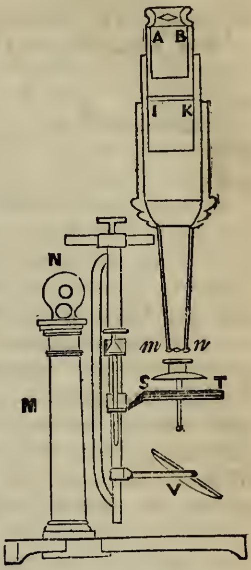

Fig. 284.

In microscopes the defective action of lenses, known as chromatic aberration, and described in Chapter XL., interferes, and, by imparting prismatic colours to the edges of objects, tends to make them indistinct. To overcome this difficulty, achromatic object-glasses are used in the finer kinds of instruments.

Besides chromatic aberration, there is another defect to which lenses are subject. It arises from their spherical figure, and hence is designated *spherical aberration.* Let P P, Fig. 285, be a convex lens, on which rays, E N, E N, E M, E M, E A, from any object, E *e*, are incident, it is obvious that the principal ray, E A, will pass on through B to F without undergoing refraction. Now, rays which are near to this, as E M, E M, converge by the action of the lens to a focus at F; but those which are more distant, and fall near the edges of the lens, as E N, E N, converge more rapidly, and come to a focus at G. Thus images, F *f*, G *g*, are formed by the extreme rays, and an intermediate series of them by the intermediate rays, the whole arising from the peculiarity of figure of the lens. It is, indeed, the same defect as that to which spherical mirrors are liable, as explained in Chapter XXXVI.; and hence, to obtain perfect action with a spherical lens, as with a spherical mirror, its aperture must be limited.

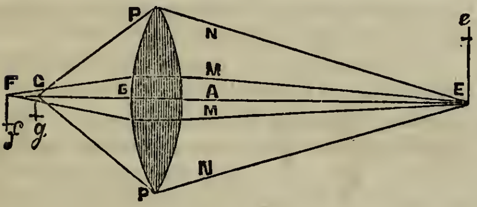

Fig. 285.

PRACTICAL ESSAYS ON EDUCATION.

THE BED-ROOM, ETC.

To secure even a certain amount of ventilation in bed-rooms, it is absolutely necessary that they should have either fire-places or flues by which the air may escape, and thereby a current be produced. Windows alone are insufficient for this purpose, as although in fine and warm weather they may be kept open throughout the day, yet in wet weather, and during the night, this cannot be permitted; and therefore for many hours, and at night especially, when the rooms are closely shut, and several boys sleeping in each of them, the air is quickly and greatly fouled, and very injurious to the health of the sleepers. Even though the rooms may have chimneys, the air in them is only partially changed; for a large quantity in the upper parts of the rooms will not descend and pass away by the chimneys; it will lurk about the ceilings and in all the corners, and thence can only be made to move by passing through the windows when their upper sashes are dropped; and only perfectly then, if the window-heads reach quite to the ceiling. It is for this reason that the windows of all sleeping-rooms should reach the ceiling, as the only means by which the air can be completely changed.

A very good means to make an escape for the heated foul air at the upper part of the room, in such way that no violent draught is produced, whilst a circulation of air is at the same time produced in every part of the chamber, is, that the ceiling should "cone" towards the centre, in which should be an aperture leading to a flue carried between the ceiling and the flooring above, and thence running up within the wall, or within the rooms above, to the top of the house, either within or without the roof, and there opening, but provided with a whirling fan, so arranged, that while it allows the escape of the air from below, it prevents the descent of cold air from above. In this way, without difficulty, the air in the upper part of the room is changed.

In rooms with flat ceilings nearly the same results may be produced by cutting a hole or holes, according to the size of the room, through the ceiling, and making the space between any two joists above a horizontal flue, which by another hole or holes in the floor above may be made to communicate with a wooden vertical flue placed against the wall, and running up through the upper rooms till it reach the roof.

Within the last few years a very simple and ingenious contrivance has been invented by Dr. Neil Arnott, for ventilating rooms, which very effectually answers the purpose. It is called "The Ventilating Valve." It is a contrivance placed in an opening made into the chimney-flue near the ceiling (not nearer than nine inches to any timber or other combustible substance, according to the building act), by which all the noxious air is allowed at once, in obedience to the chimney-draught, to pass away, but through which nothing can escape backwards into the room.

Whatever apparatus may be used to aid the ventilation of sleeping-rooms, if the weather permit, the window-sashes should be opened, so that the air may enter, both above and below, as soon as their occupants have left them.

Children should retire early to bed, and rise early in the morning. They should not be allowed to expose themselves much to the evening air, for it is noxious to the blood, especially in autumn. They should be allowed to court the morning breeze, for it is full of invigorating influences.

"Early rising," says Dr. Grindrod, "is as essential to the maintenance of health, as early rest." The old adage, "early to bed and early to rise," must be familiar to all our readers. Many of our most eminent writers, whether of ancient or modern times, attribute their vigorous health and extraordinary mental efforts to the practice of early rising. Among other illustrious examples, I may mention Alfred of England, Sir Thomas More, Linnæus, Bishops Barnet, Horne, and Jewell, Drs. Tissot, Paley, Kippis, Franklin, Priestley, Parkhurst, Doddridge, Sir Walter Scott, Buffon, and a host of others distinguished for their intellectual labours.

Dean Swift avers, that "he never knew any man come to greatness and eminence who lay in bed of a morning."

Dr. Doddridge was deeply sensible of the importance of early rising. "I will here," he says, "record the observation, which I have found of great use to myself, and to which I may say that the production of this work ('Commentary on the New Testament'), and most of my other writings, is owing—viz., that the difference between rising at five and at seven o'clock in the morning, for the space of forty years, supposing a man to go to bed at the same hour at night, is nearly equivalent to the addition of ten years to a man's life."

"Pay the utmost attention," says Hufeland, in his famous treatise, entitled "The Art of Prolonging Life," "to cleanliness; for the greater part of poisons of this kind (contagions) are conveyed to us through the external surface of our bodies; and it is fully proved that poison, already communicated, has been by cleanliness removed before it could actually produce any bad effect. I here allude, in particular, to frequent washing, bathing, rinsing the mouth, combing the hair, and often changing the linen, clothes, and bed."

There are other consequences of neglected ablutions which I may dispose of by using the words of Mr. Erasmus Wilson:—"If the pores of the skin be obstructed, and the transpiration checked, the constituents of the transpired fluids will necessarily be thrown upon the system; and as they are injurious, even poisonous if retained, they must be removed by other organs than the skin. These organs are the lungs, the kidneys, the liver, and the bowels. But it will be apparent to every one, that if these organs, equally, or one more than another, which is generally the case, be called upon to perform their own office *plus* that of another, the equilibrium of health must be disturbed, the oppressed organ must suffer from exhaustion and fatigue, and must become the prey of disease. Thus, obviously and plainly, habits of uncleanliness become the cause of consumption and other serious diseases of the vital organs. Again, if the pores be obstructed, respiration through the skin will be at an end, and, as a consequence, the blood, deprived of one source of its oxygen, one outlet for its carbon, the chemical changes of nutrition will be insufficient, and the animal temperature lowered. As a consequence, cutaneous eruptions and diseases will be engendered."

With such considerations before us, ablution becomes a necessity which needs no farther argument to enforce strict attention to its observance.

The simplest mode of applying water to the skin, is by means of the wetted sponge. In this mode, a part only of the body is exposed at a time; and as soon as that part has been briskly sponged, and as briskly wiped dry, it may again be covered by the dress. The whole body may in this way be speedily subjected to the influence of water, and to the no less useful friction which succeeds it in the operation of drying. It was this form of ablution which was used by Sir Astley Cooper; and to it he attributed much of his unusually robust and excellent health.

With regard to the soap,—the common yellow soap, thoroughly dried, is the best.

Ablution should take place as soon after rising from bed as possible.

Cleanliness is the best safeguard against *ringworm*, that "bane of the schools." Soap, water, the small tooth-comb, and the brush, are also important auxiliaries to cure. In the early stages of the disease—should you be so unfortunate as to have it make its appearance among your pupils—washing once a week will be sufficient; in the later stages, ablution should have for its object the removal of the crusts which form over the diseased surface. After washing and drying the head, some simple pomatum should be used. Domestic treatment should be limited to these means, as true ringworm "is always associated with some error of the constitution which the medical attendant of the school alone can treat efficiently." It is scarcely necessary to add, that every precaution should be used which is calculated to prevent contagion. Ringworm carries with it an unpleasant *prestige;* and although medical men are generally of opinion that the disease is *not* contagious, I would not recommend the neglect of means adapted to render such an event impossible. A remedy, popular among the boys, is common black ink; but it is an application of the most filthy, and often of the most irritating kind.

I will conclude this paper by mentioning the mode of treating some of the minor accidents to which children at school are subject. I beg to acknowledge the source whence I have procured the information—Dr. J. F. South's "Household Surgery."

Children sometimes swallow pieces of money, buttons, nails, or anything else they can put into the mouth and get down. These accidents are seldom of any consequence; the money or other substance usually accompanies the food through the bowels, and is in due time—sometimes sooner, sometimes later—discharged with the motion; and the more solid the latter is, the more likely it is to entangle the money. Purges should be avoided, unless recommended by the medical attendant.

Children often amuse themselves with poking things with which they are at play into their noses and ears. If peas, beans, or any other seed or substance be thrust in, which swell as they imbibe moisture, no time should be lost in getting them out; otherwise, as they enlarge, they become more firmly fixed, and much more difficult to be removed. If the pea, &c., be in the nostril, the child should be ordered to draw his breath in deeply, and then closing the other nostril with the finger, and closing the mouth firmly, to snort forcibly through that side of the nose in which the substance is lodged. If this be done soon after the accident, two or three efforts usually shoot the unwelcome lodger out.

It is of much greater consequence when anything has been pushed into the ear, as, though the passage is short, its nearly circular form and smooth surface more readily permits its being quickly thrust down to the drum of the ear. The doctor should be immediately sent for in such cases.

THE DECIMAL COINAGE.

BY DR. J. R. YOUNG.

ALTHOUGH an article on this subject was published in number 66 of the FAMILY TUTOR, yet it is one of such commercial and social importance, that no apology, in returning to the inquiry, may be necessary.

The article referred to was intended to exhibit some of the advantages of the proposed change in our monetary system, on the supposition that our present *pound* is to remain as it is. Let us examine a little into the facilities introduced by changing the pound, and allowing the *farthing* to remain as it is.

And first, we would remark, that whatever value we give to the highest money-unit, and by whatever names we call the decimal subdivisions of it, the facilities of calculation are pretty nearly the same. They are, indeed, *exactly* the same, as far as the inferior denominations are concerned. The only difference is, that the *smaller* the value of the highest unit, the *larger* will be the number expressing what we now call *pounds.*

As, therefore, the value of the money-unit is of but little moment in other respects, it seems that it should be chosen almost exclusively in reference to these two objects, namely—1st. It should be chosen so as to disturb, as little as possible, existing notions. 2nd. It should be chosen so as to render a sum of money, in the old notation, readily convertible into that of the new, *without sacrificing even the smallest fraction of a farthing.*

To accomplish these objects, the highest money-unit should be 250 *pence;* that is, 10d. more than our present pound; the value of the next inferior unit would be 25d.; this may be called a *florin.* Leaving, however, the *names* of the two denominations, intermediate between the highest and lowest, open to further consideration, we have the following scale of values expressed in *pence:—*

1 Pound			1 Farthing
250d.,	25d.,	2·5d.,	·25d.

The farthing is thus preserved; and therefore the halfpenny and the penny may remain as at present.

Let us now see how a sum of money, in the old notation, is to be converted into an equivalent sum in the new. Suppose the sum to be £3 17s. 7¼d., reduce it to farthings:—

£3 17s. 7¼d.
20
—
77
12
——
931
4
——

∴ £3 17s. 7¼d. = £3·725 in the new notation.

All we have to do, therefore, is to reduce the proposed sum to *farthings,* and then to point off *three* places for decimals. It is plain that here, as in the old system, the lowest money-unit is the farthing; and that when, as is usual, fractions or decimals of this lowest unit are disregarded, the *third* is the last place of decimals. But if decimals of a farthing are included in the old notation, we shall merely have to append these same decimals to those already in the new: thus, if the above sum had been £3 17s. 7¼d. + ¼ f., then the same sum, in the new notation, would have been £3·725¼, or £3·72525.

This conversion of the old money into the new, is merely the application of the principle that 1000 *farthings* = 1 *new pound;* so that, to return from the new to the old, we have only to remove the decimal point three places to the right, and to convert the resulting *farthings* into £ s. d.

Dr. Nuttall's paper, in page 153, conveyed an ingenious plan for decimalising, or centesimalising, our money accounts, without abolishing our existing coinage. It is, however, to be feared, that any system which, like that, gives only approximate results as respects farthings, in particular instances, will not meet with general acceptance, and, moreover, it is a *decimal coinage* that is the subject of so much discussion at present, and not a plan for decimalising the existing money.

Should the scale of coins, here recommended, be adopted, the half-crown and crown may be advantageously retained, the former as a 30d. piece, the latter as a 60d. piece; but as a tenpenny piece, under whatever name, would no doubt be introduced, the half-crown would be a 3 *ten-piece,* and the crown a 6 *ten-piece;* there might, too, be a *half-ten-piece,* or *five-piece,* and there *must* be a *quarter-piece.* As to what *names* might be most suitable for the coins thus designated, we offer no suggestion; accounts would be kept only in *pounds, florins, quarter-pieces,* and *farthings;* the other coins, the ten-piece and the five-piece, like the crown and half-crown, and the sixpenny, fourpenny, and threepenny pieces at present, being used only for commercial and personal convenience.

There would be no necessity abruptly to annihilate the shilling; it might be suffered gradually to die out, as a thing not wanted, though not in the way. People would soon become reconciled to the *ten-piece,* which would speedily supplant the *twelve-piece.* Twenty-four of them would make the old pound, and twenty-five the new one; the new pound being equal to the present sovereign and a ten-piece.

As stated above, I do not offer any suggestion as to what *new* names are best suited to the proposed new coins; but my opinion is, that there should be no alteration in the existing nomenclature of *accounts,* except this :—Let the principal gold coin be called an *imperial pound;* the 25d. piece, an *imperial shilling;* and the 2½d. piece, an *imperial penny.* The money of accounts would thus be distinguished from the old money by a dignifying appellation. The symbols for the imperial money should be £ S. D.; the symbols for the old being l. s. d. In oral statements, or in reading accounts aloud, we should call such a sum as £4 6S. 8·3D., four pounds, six shillings, and eightpence three farthings, *imperial;* and such a sum as 4l. 6s. 8¾d., four pounds, six shillings, and eightpence three farthings, *old money.*

There would be no necessity for the decimal point at all, except as a mark to separate the farthings from the pence. A matter of serious perplexity to the uneducated, would thus be avoided. The point, or comma, separating the farthings from the pence, so far from an annoyance, would be regarded as a convenience by the uneducated man; and the word *decimal* need never to afflict his ears. The distinction between *imperial* pound (£), and *old* or *common* pound (l.); between *imperial* shilling (S), and *old* or *common* shilling (s.); and between *imperial* or *silver* penny (D), and *common* or *copper* penny (d), could occasion no difficulty; the prefix *imperial* would gradually go out of use with the disappearance of the old coins. As observed above, these need not be recalled; they might be suffered to become exhausted, except the 3d., 4d., and 6d. pieces, to be superseded by the 2½d. and 5d. pieces—the *copper* penny, halfpenny, and farthing, being *permanently* retained.

The following specimen of an account offers nothing to disturb existing notions, or to offend popular prejudice:—

£	S.	D.	
13	5	7·1	
7	8	9·2	
3	1	6·5	
5	9	8·6	37374 farthings
2	3	4·3	9343½d.
4	4	1·7	778s. 7d.
£37	3	7·4	*Impl.* = 38l. 18s. 7½d. *old.*

The amount, *imperial money,* is—Thirty-seven pounds, three shillings and sevenpence four farthings; the four farthings being one *copper penny.* The amount, *in farthings,* is furnished by the row of figures themselves, viz., 37,374 farthings; and dividing by 4, 12, and 20, we get the amount £38 18s. 7½d. in *old* money. Whether the money, in any written account, be old or imperial, is sufficiently indicated by the symbols. The terms of distinction are required only in an oral statement of it.

As to the coins of commerce, they might be as follows :—

Gold.—Imperial pound (£), half pound.

Silver.—Crown; half-crown; imperial shilling (S); 10d. piece; 5d. piece; 2½d. piece; that is, the imperial or silver penny (D).

Copper.—Penny; halfpenny; farthing; as at present.

The imperial shilling, or 25d. piece, would bear the same relation to the 10d. piece, that the half-crown does to the present shilling, and the lowest three silver coins would have to one another the same relation as the three copper coins. The silver coins here proposed, by whatever names the *pieces* be called, are six in number;* if the imperial shilling were made a little smaller in surface than the florin, but thicker, they could all six be easily distinguished, and any one of them be identified even in the dark. The florin would, of course, be entirely superseded by the imperial shilling.

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DECIMAL SYSTEM OF WEIGHTS AND MEASURES.

We have already entered upon the subject of the decimal system of money, as propounded by the Government Commissioners. Let us now briefly advert to the changes proposed for decimalising the *Standards of Weights and Measures*, which at present are so replete with inconsistency as completely to bewilder our arithmetical students, and present difficulties, in the ordinary business of life, where none ought to exist.

With regard to the *Standard of Weight*, the Commissioners recommend the adoption of the following decimal scale:—1 grain, 10 grains, 100 grains, 1000 grains, 100,000 grains, and several multiplies of each; 1 Troy ounce, 10 Troy ounces, 100 Troy ounces, or any of its multiples; also the tenth, the hundredth, and the thousandth parts of a pound Avoirdupois, with their several multiples. It is recommended that all weights of 14 lbs., 28 lbs., 56 lbs., 112 lbs., or any of their multiples, shall be abolished; and that the only legal weights above *one pound* shall be weights consisting of multiples of *one pound* not exceeding 10 lbs., and weights consisting of multiples of 10 lbs., not exceeding 100 lbs.; that the name *Centner*, or some other name to be fixed by Act of Parliament, shall be recognised as describing the weight of *one hundred pounds;* and that the Government shall consider the expediency of some plan by which the former or *old* weights may be withdrawn, and the latter or *new* weights may be made to take their place. According to this recommendation, the extension of the Avoirdupois weight would, following the example of the French, stand thus:—

10 pounds = 1 decicentner,
100 pounds or 10 decicentners = 1 centner,
1000 pounds, or 10 centners = 1 decacentner,
10,000 pounds, or 100 centners = 1 hecatocentner.

The alterations proposed in our present *Standard of Measures* is important. According to the table of "Long Measure," as given in our "Tutors," the English mile is composed of 8 furlongs, and each furlong of 220 yards in length; therefore, the English mile contains 1760 yards in its length. The Commissioners propose an important change in the length of the mile, namely, that it shall contain only 1000 yards, and that it shall be denominated *Milyard*, or some other name to be fixed by Act of Parliament. They also recommend that all our itinerary distances shall be measured by the *Milyard*, and that marks be set up at every such distance of 1000 yards; that distances less than this shall be measured in yards and decimal parts of a yard; or in feet and decimal parts of a foot.

The Commissioners also recommend, that in all surveys of land, &c., the acre and its decimal parts shall be employed for the measurement thereof. They propose that the term *square chain*, or *chain*, shall be recognised as describing the *tenth part* of the acre, and that some name shall be recognised as describing the *thousandth part* of the acre. If a name were adopted, similar to that employed by the French in their decimal system, it would be the *Centi-chain*, or the *Milliacre*, and this measure would contain 4·84 square yards. On this part of the subject, they recommend that the method of expressing *Land Measure* in *acres*, *roods*, and *perches* shall be abolished, and that it shall be required in future to express such measures in *acres* and *decimal parts* of an acre. According to this proposed new arrangement our old measures, as compared with the new, would stand thus :—

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* The copper penny being known, the designations 10d. piece and 5d. piece, are significant of value; why merely arbitrary names should be devised we cannot see. The appellations *imperial* pound, shilling, and penny, which I propose to preserve in accounts, are as euphonious as any that could be given as *names* to the coins. At present the *pound* of accounts, is the *sovereign* of commerce. Why should our money system be complicated by a double nomenclature?

Old Measures.		*Square Chains.*
1 square inch	=	0·0000013+
1 square foot	=	0·0002066+
1 square yard	=	0·0018595+
1 square perch	=	0·05625
1 rood	=	2·25000
1 acre	=	10·00000

Proposed New Measures.		*Square Yards.*
1 centichain or milliacre	=	4·84
1 decichain or centiacre	=	48·4
1 chain or deciacre	=	484·
1 acre	=	4840·

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ON THE STUDY OF EUCLID.

V.—THE PROPOSITIONS. BOOK I.

(*Continued.*)

Proposition VII. is merely subsidiary to the proposition next following; it is what in some geometrical writings would be called a *Lemma.* You see that the demonstration of it rests almost entirely on Proposition V. In some books on geometry this proposition is dispensed with, and the eighth established independently of it; but, as an intellectual exercise, Proposition VII. is as useful as any in the book. Besides, a proposition, though manifestly introduced as merely subsidiary to something else, may yet possess intrinsic excellence of its own sufficient to justify its retention in the system. For instance, the proposition before us teaches us this fact, which is certainly not without interest; namely, that a physical triangle, supposed to have its sides freely moveable about joints at its vertices, cannot possibly be thrust out of shape by any force whatever. You may break the bars forming the framework, but you cannot make the frame itself assume another shape. It is a very different thing with the frame of a common school-slate, as, I dare say, you well know from practical experience; for I have no doubt that you have often twisted such a slate-less frame into a great variety of shapes. You now know, not from experiment, but from abstract science, that this would have been impossible if your slate-frame had been triangular, instead of rectangular.

Proposition VIII. is the *second* proposition in the geometry of triangles, which proves that two triangles are equal in every respect—that is, that each is but an exact copy of the other—provided *three* things in one are respectively equal to three corresponding things in the other. The three things may be two sides and the included angle, as we learn by Proposition IV., or the three sides, as the present proposition teaches. And I may as well observe here, that there is only one other proposition in the Elements where the like equality of two triangles is inferred from an equality of three things in one to three corresponding things in the other—it is Proposition XXVI. On these three propositions the practical part of *plane trigonometry* is founded. A triangle, in the language of trigonometry, is said to have six *parts*—the three sides and the three angles—and when certain sets of *three* of these are given—either of the sets, namely, mentioned in Propositions IV. VIII. and XXVI.—the remaining three, which we see by these propositions, must be fixed and invariable, become determinable, and are matters of computation.

The four propositions next following are *problems.* You may be pretty sure that Euclid has postponed them till they became indispensable. I don't think Euclid *liked* problems; at all events, there is less careful finish about them than in his theorems. Proposition IX., for instance, needs mending a little; it professes to teach how to bisect an angle, of whatever magnitude it may be. Now, suppose that the triangle, A D E, in the book, is an *equilateral* triangle, and that we want to bisect the angle D A E. Euclid tells us to construct an equilateral triangle on D E; and without the diagram before our eyes, where the construction is exhibited in its completed state, we should naturally describe the equilateral triangle he directs, *above* D E, and not *below;* in which case we should get nothing, for our new equilateral triangle would simply cover the one already there, and the point, F, falling on A, would have no separate existence; so that there would be no guide to the drawing of A F, the bisecting line; it should have been distinctly stated, therefore, that the equilateral triangle, to be described on D E, should have its vertex, F, on the opposite of D E to the point A.

In going over Euclid's propositions without the book, as I recommended in my last paper, always refrain from *copying the diagrams.* I know that such is the usual practice; but it should be condemned. The progress of the diagram should just keep pace with that of the text, and no line should be introduced till it is actually demanded by the text. It would be nearly as faulty to write out the whole text, and then to supply the diagram (as the boy did who said he would tell the story first and draw the picture afterwards), as to commence with the completed diagram, and then supply the text. In a printed book, the diagram must, of course, be presented *completed;* but in your own private practice you should make it grow to maturity along with the text. In the whole course of your geometrical studies, let me urge upon you never to allow your judgment or conviction to be in the slightest degree biassed by your visual impressions from the *diagram.* Let two lines look ever so like equal lines, don't forestall the reasoning and conclude them equal; remember always that you are engaged in a purely *intellectual* process, and that you are not to be allured by the *matter* from the *mind.* Graphical accuracy, in the figured form, is of no moment; logical accuracy, in the abstract reasoning, is all that you have to attend to; and therefore I think it worse than waste of time to be over scrupulous with scale and compasses, in reference to the lines introduced into Euclid's demonstrations; but I gave you some hints on this matter at pages 11 and 42.

I do not see anything that calls for special notice till we reach Proposition XVI. This is easy enough, as far as Euclid carries the demonstration; but when, at the close, he says, "in the same manner it may be demonstrated," a beginner is likely to feel a difficulty. There is really a good deal to do before the proof can be completed; and, when completed "in the *same* manner," there is a needless amount of complication. I would advise you to finish the reasoning rather differently. By carefully looking at the argument, you will see that this truth is established, and nothing more; namely, that if one side of a triangle (*any* side, of course,) be produced, the exterior angle is *greater than that interior angle which is opposite to the side thus produced;* the angle, A C D, is thus greater than A. Let now A C be produced to G, then, since the exterior angle is greater than that interior one which is opposite to the side produced, the angle, B C G, is greater than A B C; but B C G is equal to A C D (by the 15th), therefore A C D is greater than A B C; but A C D was shown to be greater also than B A C; *therefore* A C D is greater than *either* of the interior and opposite angles, B A C, A B C.

Proposition XVII. would seem, at first sight, to have been introduced without any object. The truth of it is clearly implied in Proposition XXXII., and it is not required in any of the intervening propositions. But that Euclid had an object is not to be questioned; and it seems to have been this—It was desirable that, at some convenient place, before the introduction of the theorems respecting parallel lines, something should be established by demonstration that would diminish the repugnance, very properly felt at the outset, to the *twelfth axiom.* You know I recommended you (p. 43) to keep this axiom in the back ground till you arrived at Proposition XXIX., where a reference to it becomes indispensably necessary. The axiom is no other than the *converse* of this seventeenth proposition; *this* shows that if two meeting or non-parallel lines, B A, C A, be cut by a third line, B D, the two interior angles, C B A, B C A, on the same side of it, are together *less than two right angles;* and the twelfth axiom asserts, *conversely,* that if a straight line cutting two others make the two interior angles on the same side of it *less than two right angles,* those others must be non-parallel or meeting lines.

The seventeenth proposition, therefore, enables us to see more clearly the exact amount of assent demanded of us by the twelfth axiom, and prevents our overrating that amount; if two lines cut by a third *meet,* the two interior angles are less than two right angles—this is *proved;* if two lines, cut by a third, make the two interior angles less than two right angles, *they meet* —this is *assumed.*

Passing over, for the present, the intermediate propositions, let us suppose Proposition XXIX. to be reached. The two propositions immediately preceding sufficiently show that the lines called parallel *exist;* the twenty-ninth demonstrates a property of them, admitting the truth of the axiom just mentioned. Geometers without number have tried, some to evade this axiom altogether, and others to prove it by establishing the converse of Proposition XVII.; but all have failed. What can be the cause of this failure? Is it not in the imperfect definition of a *straight line?* Our conception of a straight line, independently of all formal definition, necessarily involves two ideas; namely, that of *length*, and that of *uniformity of direction*. *Length* is implied in the word *line*; and *invariability of direction* in the term *straight*. A line which changes its direction is a *crooked* line or a *curved* line; a line that never changes its direction is a *straight* line. Now it necessarily follows, from this uniformity of direction, that if two straight lines, however far prolonged, can *never* meet, then at no part of their course can either make any *approach* towards the other; for if two lines, proceeding in any two directions, *approach* and continue undeviatingly to pursue those directions, they cannot fail eventually to *meet*. It follows, therefore, that parallels must *throughout* be equidistant; but *two* distinct straight lines, through the same point, cannot throughout be equidistant from a third; so that *two* straight lines through a point cannot *both* be parallel to the same straight line.

Proposition XXVIII. shows that *one* (A B) will be parallel to another (C D), provided a line, cutting both, makes the interior angles together *equal* to two right angles; a *second* line, through G, which causes the interior angles to be *less* than two right angles, being distinct from A B, must therefore meet C D, if prolonged; and this is the assertion of the twelfth axiom.

What is here said, remember, is not a *demonstration* of this axiom. An *axiom*, you know, is an indemonstrable truth. All I wish to show is, that it *is* an axiom; that is, a truth necessarily implied in the correct conception of the thing to which it refers. If you steadily contemplate your conception of a straight line, giving due consideration to its distinguishing peculiarity—*uniformity of direction*—you must see that *two*, from the same point, cannot *both* be equidistant from a third; *one* may be parallel to this third, or everywhere equidistant from it, since, as we have seen, parallels are *possible*; but *one* must of necessity meet it.

Of the propositions passed over, the 22nd and 24th are the only ones requiring any special notice here. Both these, as given in the text of Dr. Simson, are open to objection. In the first of them, it is taken for granted that the two circles employed in the construction must *cut* one another; and in the second, it is assumed that the point F falls *below* the line E G. You will find these defects acknowledged in the notes at the end of Simson's Euclid; but they were first pointed out by Mr. Thomas Simpson, in his Elements of Geometry. The emendations of the latter were, however, but ill received by the "restorer of Euclid," who treated "the remarker," as he called him, with a good deal of contempt; the more to be reprobated, as the poor self-taught weaver (for such Simpson in early life was) was very superior as a man of science to his academical opponent, great as were the merits of the latter in the field of ancient geometry. The biography of Thomas Simpson is full of instruction and encouragement to the young and unaided student, who cannot fail to view with interest the steps by which a person in Simpson's position, without books, money, or friends, plying his humble calling among the lowest ranks of society, was conducted, by the force of perseverance, to the proud eminence which he eventually attained. In the annals of science he ranks among the most distinguished mathematicians of the last century; and yet, at the age of nineteen, he was ignorant of the first rudiments of common arithmetic.*

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PRACTICAL LESSONS IN DRAWING.†

SEVENTH LESSON.

As you are now able to draw outlines correctly, it will be necessary to study light, shade, and reflection, which will give the appearance of substance to the objects you wish to delineate.

If we consider light as applied to drawing, we must do so under four distinct heads,—1st, as *natural light*, or that emanating from the sun when it rises

> "At morning, flinging wide
> Its curtain-clouds of purple and vermilion,
> Dispensing life and *light* on every side;"

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* Some account of Simpson will be found in "The Pursuit of Knowledge under Difficulties;" as also in Dr. Hutton's "Mathematical and Philosophical Dictionary."

† Continued from p. 14.

or when the silvery moon pours

> "Her chastened radiance on the scene below;
> And hill, and dale, and tower
> Drink the pure flood of *light!*"

The effects produced by the same placid beams have been the delight of artists from the earliest times, as they have

> "Cast a wide and tender light,
> Which softened down the hoar austerity
> Of rugged desolation, and filled up,
> As 'twere anew, the gap of centuries."

2nd, as *artificial light*, or that derived from combustible bodies; 3rd, as *direct light*, or that light which reaches an object directly, without passing through or being reflected from one object upon another; and 4th, *reflected light*, or that light which, when it is received by one object, is thrown off or reflected upon another, as from glass or water.

No person who has studied the subject, or in fact any one who has given the least attention to it, can doubt for a moment the importance of a due attention to the subject of light. We do not expect—nay, we do not wish—our drawing-pupils to study the laws of optics; they may, and can do so, but it is not necessary. Those who wish to comprehend optics fully will find ample instruction in our course of Natural Philosophy, now publishing in this work.

To return, however, from an apparent digression, we must request our pupils to try some *simple experiments* for themselves with regard to light before they enter upon their drawing-lesson of light and shade.

Place a cork upon the table in front of your window, and let its end rest upon a sheet of paper. You will observe a pyramidical *dark shadow*, the base of which commences at the cork, and also a pyramidical *faint shadow*, the apex or point of which corresponds with the base of the dark shadow; and you will also observe that a portion of the cork is *faintly*, another portion *deeply*, and another portion *semi*-shadowed.

Place the cork upon its side, and you will obtain nearly the same results; but with this difference, that the shadows are broader, and the effect produced less striking.

Substitute a billiard-ball, a marble, or a bullet for the cork, and the effect is nearly the same, only that the shadow is elliptical, or somewhat oval, instead of pyramidical.

Roll up a piece of paper so as to form a cone, gum down one of the corners, and cut off the base, so as to be even; then set this upon a piece of paper, and you will obtain the same shadows as when you employed the cork, which may be easily proved by placing them side by side.

Many similar and simple objects will readily suggest themselves to the pupil, and should be used as familiar examples to practise light and shade.

From what you have seen, it will be evident that all opaque or non-transparent objects, upon which light happens to fall, must be partially in shadow, whether the light falling upon them be reflected, natural or artificial; while other parts will be illuminated, and therefore placed in strong contrast with those parts of the object that are in shadow.

Shading is intended to impart the appearance of solidity to objects, so that the amount of depth of shading in a drawing conveys the idea to the mind of the beholder —1st, that the object delineated is in relief, or projects from those surrounding it; 2nd, as regards the relative position of one object with regard to another; and 3rd, the distinctive distances of objects from the person viewing them.

Shadows are either natural or accidental. *Natural shadows* are those that the lover of nature beholds as he rambles through the lone copse, the tangled wood, or river's margin, where

> "The barks at anchor cast their lengthened *shades*
> On the gray bastioned walls."

Those who aspire to be artists—nay, even the timid amateur, content to toil over the well-beaten path that thousands have journeyed over before—must ever be on the alert to gather studies from nature, as

> "The shades of evening softly creep"

over the gentle slopes where innocent lambs feed, or frisking kids nip the tender grass; nor must they despise the lessons furnished by many a quickset hedge or ruined wall, over which

> "Some trees
> Whose massy outline of reposing shade"

seem placed to tempt the artist to linger on his journey and take a sketch. We have several lovely sketches of what artists term "bits," snatched in haste from many a bright spot where we have rested in our rambles, even as the

> "Shadows, nursed by Night, retire,"

or the sun's bright beams were first welcomed by returning morn. These each convey lessons—pleasing lessons—not only of artistic but of religious instruction, which gushes forth as we view their beauties. To enjoy such thoughts, to sketch such views, and to treasure up their lessons, we must leave the busy haunts of men, and freed from care, and toil, and noise, seat ourselves beneath the umbrageous arms of some ancient tree, and gaze upon

> "A surface dappled o'er with shadows, flung
> From many a brooding cloud."

If a ball is placed upon the table, and a ray of light allowed to fall upon it, the side near to the light will appear different from the other part upon which the light does not fall, as may be seen in Fig. 29, in which A represents the point from which the ray of light proceeds until it falls upon part of the ball, *d e*, which thus receives direct light, while the other part (*c*) is in natural shadow or shade. You will also observe that there is a long pyramidical shadow thrown upon the table, the result of the non-transparency of the ball.

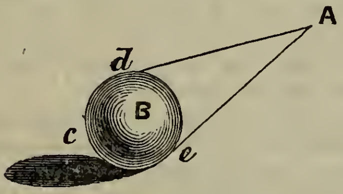

Fig. 29.

Having directed your attention to the preliminary and important points connected with light and shade, it now becomes necessary to make some observations upon shading.

In shading there are three kinds of manipulation requisite—1st, waving; 2nd, stippling; and 3rd, cross-hatching. There are certain rules connected with shading which must be generally observed; for it will be found that much of the appearance of objects depends upon the shading employed; for it is by means of the kind of lines used that the projection of bodies from one another, and the appearance of the materials of which they are constructed, are conveyed to those who only possess the opportunity of viewing the sketch. Colour is at all times better adapted to depict the skies, portraits, &c., than drawings of uniform tint, however well the latter may be executed.

The strokes used in shading may be of uniform thickness or not, and they may also be placed at regular or irregular distances. If of uniform thickness (as *a*, Fig. 30), they give the same tone to a drawing that one colour would, if it were placed upon the paper; but if the same strokes are drawn closer together in one part of the drawing than in the other (as *a*, Fig. 30), then that part will have a deeper tone. The same result holds good with respect to oblique lines (as in *b*, Fig. 30). If the lines become darker or broader, and nearer to each other as they recede from the light, then they will convey the impression of an increased depth of tone (as in *c*, Fig. 30), whether the lines be oblique, perpendicular, or horizontal. All lines used in shading do not take the same direction, as, in addition to those mentioned above, some are semi-circular.

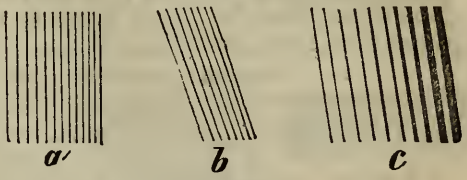

Fig. 30.

Here is a figure (Fig. 31) that combines outline and shading, and forms an excellent study for the beginner in both, as in the former lesson it serves to illustrate the

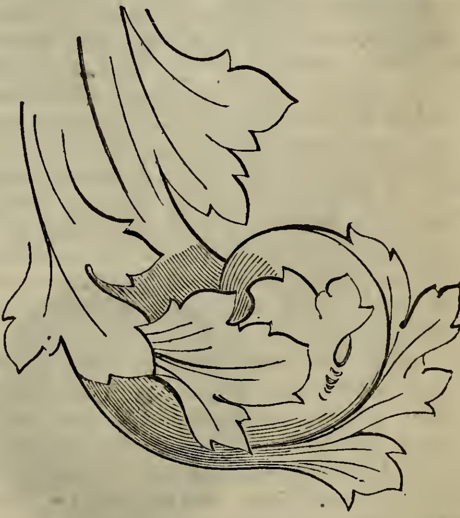

Fig. 31.

beauty and grace of curved lines, and in the latter of uniformity of shading. When treating of ornamental drawing, we shall advert to this copy again.

Waving shading is produced by a succession of strokes close together, by using a soft pencil (F or B) with a worn point. If these lines are made with a fine-pointed pencil, there is not a uniformity of tint produced, and therfore the lines should not overlap one another, but be drawn as in Fig. 33. Foregrounds, and deeply-cast shadows, broken earth, &c., require this kind of shading.

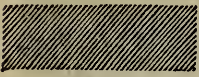

Fig. 32.

Stippling consists of a series of dots, which impart a depth or lightness of shade, just as they are made large or small, or closer or farther apart, the general rule being to make the large and close together in the depth of the shade, and gradually small and wider apart as the light is approached.

Cross-hatching is produced by drawing a number of lines in such a manner that they cross one another at right angles. They should always be commenced from the outline as in Fig. 33, and one direction of lines finished before the other cross them; otherwise unevenness of tone will be produced. They should always be thinner as they approach the light, and also wider apart. In curved objects it is necessary to observe the relative convexity and concavity of the surfaces, and to represent them by lines exhibiting a greater or lesser curvature, taking care to increase their breadth in certain parts, and diminish them in others, as may be seen in the most common engravings of concave or convex objects.

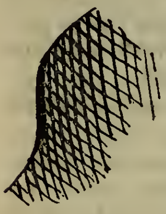

Fig. 33.

The general rule for shading is, that flat surfaces must be represented by straight lines; convex and concave surfaces by curved lines, as in Fig. 34, which represents a ball, and shows the manner of increasing the depth of tone by drawing the lines closer to each other; and all surfaces of a mixed appearance must be dealt with according to circumstances; some parts requiring curved and other straight lines, while others again will require cross-hatched lines both curved and straight.

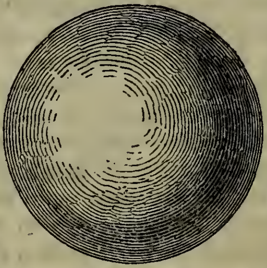

Fig. 34.

Remember that much of the perfection of shading consists in the knowledge of how much you can do, and no more, and how much your pencil will do. In order to attain perfection or even mediocrity in this department of drawing, you should practise strokes of every description, with each kind of pencil, upon sheets of paper, marked at the top thus—H:H.H; H.H.H: &c., and practise with fine-pointed and worn-pointed pencils, sometimes plain, at other times curved, and also cross-hatched strokes. By this means you will ascertain the power of your hand, and the tone of your pencil.

It is contrary to our practice to recommend any person's wares, and therefore we refrain upon the present occasion. However, we would advise our pupils *always* to purchase the best drawing materials. They are the cheapest in the long run, and will always reflect credit upon the draughtsman. Bad tools often make bungling workmen.

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LESSONS IN NATIONAL HISTORY.

No. VI.

> "The age of mystery, with its hoarded power,
> That girt the tyrant in his storied tower,
> Has passed and faded like a dream of youth,
> And riper eras ask for history's truth."

CHINA AND ITS REVOLUTIONS.

The last portion of Chinese history occupied a period of a thousand years, from the foundation of the Tang dynasty, in the seventh century, to the overthrow of the Mings in 1643,—and this forms a most eventful era in the annals of the world. During that lengthened period, the Chinese took the lead in national civilization, while the rest of the world was immersed in absolute barbarism and superstition; but during the sixteenth and seventeenth centuries the European states made rapid advances in the arts of civilization, while the Chinese in a measure remained stationary, and politically isolated from the rest of the globe;

although it must be admitted that the national greatness of the Mings, both in a naval and military point of view, was at one time equal to their splendour on the Chinese throne. From a voluminous history of the Ming family, published by the emperor of China, in 1792, we learn that Yung-loh, the third sovereign of the dynasty, who ascended the throne in 1403, had a fleet manned with 30,000 sailors, which at various times went to the Moluccas, Jàva, Borneo, Manilla, Sumatra, Cochin-China, Siam, Malacca, Bengal, and Ceylon. These ships brought back to China enormous riches; and all the princes of the countries which they visited sent embassies to the sovereign of China.

The following is a chronological summary of the various sovereigns of this illustrious house, the last of whom perished in 1643:—1. Hungwu, the founder of the dynasty, who ascended the throne in 1368;—2. Kienwan, in 1398;—3. Yung-loh, in 1403; 4. Hunghi, in 1425;—5. Siuentih, in 1426;—6. Chingtung, in 1436;—7. Kingtai, in 1457;—8. Chinghwa, in 1465;—9. Hungchi, in 1488;—10. Chingtih, in 1506;—11. Kiahtsing, in 1522;—12. Lung-king, in 1567;—13. Wanleih, in 1573;—14. Taichang, in 1620;—15. Tienki, in 1621;—16. Tsungching, in 1628.

After the death of the last of the Ming sovereigns, the native Chinese made many determined efforts to expel the usurping Tartars, and restore the ancient line; but they were all unavailing. The last pretender to the Ming throne, who was descended from the royal blood, was Yungleih, a Christian prince who assumed the name of Constantine. His wife and mother, and all his generals, were also Christians. His troops, however, after an arduous struggle, were defeated; and Constantine himself was treacherously strangled by Wusan-kwei, the general who had received, as a reward for his treachery in admitting the Mantchous, the principality of Yunnan and Kweichou. With this prince perished the last hopes of the Ming family.

We have now to enter upon the Tsing, or "Pure" Dynasty, as it is designated, which was established by the Mantchou Tartars, after the annihilation of the Mings; and which governs China at the present day.

Tientsung, who was the founder of the Tsing dynasty in 1644, died soon after his accession, and was succeeded by his son, Schunchi, who is usually regarded as the first emperor of the family.

During the eighteen years that Schunchi sat upon the throne, he succeeded in subduing most of the northern and central provinces; but the maritime regions of the south held out against the invaders; and one of the leaders, by means of his fleet, carried devastation along the whole coast. The spirit of resistance was in some parts crushed, and in others exasperated by an order for all Chinese to adopt the national Tartar mode of shaving the front of the head, and braiding the hair in a long queue as a sign of submission. This order was resisted by many, who chose to lose their heads rather than part with their hair; but the mandate was gradually enforced, and has now for almost two centuries been one of the distinguishing marks of a Chinese; though to this day the natives of Fuhkien wear a kerchief around their head to conceal it; and in the province of Kouang-si, in the south-east of China, there is a mountainous tribe called Mao-tzes, who have always set this order at defiance, and succeeded in maintaining their independence against the united forces of the Tartar government. This is the race which is chiefly engaged in the present successful rebellion.

Shunchí died in 1661, and was succeeded by his son Kanghi, who was eight years old at his accession, and remained under guardians till he was fourteen, when he assumed the reins of government, and swayed the power vested in his hands with a prudence, vigour, and success that have rendered him more celebrated than almost any other Asiatic monarch.

During his unusually long reign of sixty-one years (the longest of any in Chinese annals, except Taimau, of the Shang dynasty, B.C. 1637-1562), he extended his dominions to the borders of Kakand and Badakshan on the west, and to the confines of Tibet on the south-west, simplifying the administration, and consolidating his power in every part of his vast dominions. To his regulations, perhaps, are mainly owing the unity and peace which the empire has exhibited for more than a century, and which has produced the impression abroad of the unchangeableness of Chinese institutions and character.

The principal events of Kanghi's long reign are the conquests of the Eleuths, and subjugation of several tribes lying on the north and south of the Celestial mountains; an embassy across the Russian possessions, in 1713, to the Khan of the Tourgouth Tartars, preparatory to their return to the Chinese territory; the settlement of the northern frontier between himself and the Czar, of which Gerbillon has given a full account; the survey of the empire by the Romish missionaries; and the publication of a dictionary of the language. In many things he showed himself liberal towards foreigners; and the country was thrown open to their commerce for many years.

The son of Kanghi, YUNGCHING, succeeded in 1722. During his reign he endeavoured to suppress Christianity, and restore the ancient usages which had somewhat fallen into desuetude during his father's sway, and generally seems to have held the sceptre to the benefit of his subjects.

Yungching is regarded as an usurper, and is said to have changed the figure four to fourteen on the billet of nomination, himself being the fourteenth son, and the fourth being absent in Mongolia, where he was soon after arrested and imprisoned, and subsequently died in a palace near Pekin.

In 1736 Yungching was succeeded by KIEN-LUNG, who proved himself no unworthy descendant of his grandfather, Kanghi. Like him he had the singular fortune to reign sixty years, and for most of that period in peace.

Some local insurrections disturbed the general tranquillity, principally among the aborigines in Formosa and Kweichau ; and in an unprovoked attack upon Birmah his armies sustained a signal defeat, and were obliged to retreat.

The incursions of the Nipalese into Tibet induced the grand lama to apply to him for assistance, and in doing so he contrived to establish a guardianship over the whole country, and placed bodies of troops in all the important positions; so that in effect he annexed that vast region to his empire, but continued the lamas in the interval administration.

Kien-lung, during his extended reign, received embassies from the Russians, Dutch, and English, by which the character of the Chinese, and the nature of their country, became better known to western nations.

These embassies greatly strengthened the impression, on the part of the Chinese, of their superiority over all other nations; for they looked upon them as acknowledgments, on the part of the governments who sent them, of their allegiance to the court of Pekin. The presents were regarded as tribute, the ambassadors as deputies from their masters to acknowledge the supremacy of the emperor, and the requests they made for trade as rather another form of receiving presents in return, than a mutual arrangement for a trade equally beneficial to both.

Kien-lung abdicated the throne in favour of his fifth son, and retired with the title of *Supreme Emperor;* while his son, KIA-KING, had that of Emperor. The character of this prince was dissolute and superstitious, and his reign of twenty-five years was much disturbed by secret combinations against the government, and by insurrections and pirates in and about the empire. A fleet of about six hundred piratical junks, under Ching Yih and Chang Pau, infested the coasts of Kwangtung for several years, and were at last put down, in 1810, by the provincial government taking advantage of internal dissensions between the leaders.

Kia-king was as unpopular among the Tartars as among the Chinese; for while the latter were shocked at his indifference to ancient customs, the former were discontented at his neglect of the annual hunting excursions, esteemed as the grand business of life by all the Tartar soldiers, as well as by the tributary nations dwelling beyond the Wall, and which had never been omitted by his three predecessors. One of the consequences resulting from this state of affairs was the formation of secret associations called Triad Societies, which are known still to exist to a great extent, their object being to overthrow the present government, and restore the native princes to the throne. The Triads, who may be called revolutionists, knew each other by secret signs, like the Freemasons.

In the meantime, the whole country was in a very unsettled state. The province of Pechelee was overrun with armed bands, composed partly of those who had become robbers by profession, and partly of revolutionists, who joined with the banditti as a means of strengthening their force. All

TAU-KWANG SAVING HIS FATHER'S LIFE.

were equally terrible to the peaceable inhabitants, who were plundered with impunity, the robbers coming in such numbers as to intimidate the magistrates, some of whom were possibly more inclined to encourage than to oppose them.

In the year 1813, the palace at Pekin was suddenly attacked by a numerous body of armed men, who forced the gates, and rushed into the great hall, with the intention of seizing the Emperor, and obliging him to abdicate the throne. A similar attempt had been made ten years previously, since which time Kia-king had taken care to have a strong body-guard in constant attendance; and besides this precaution, a double guard was posted at every gate; therefore it is supposed the conspirators must have had confederates within the palace, who facilitated their entrance; otherwise there must have been a desperate struggle with the soldiers, which does not appear to have been the case.

A terrible scene of confusion ensued. The princes and attendant officers surrounding their sovereign made a gallant defence; and his son, TAU-KWANG, who succeeded to the empire, had the good fortune to save his father's life, by shooting two of the insurgents who were in the act of rushing upon the Emperor. Much blood was shed before the palace was cleared of the assailants, who were, however, at length dispersed, and the insurrection subdued.

The reign of Kiaking ended in 1820, and by his will his second son, whose timely aid preserved his life, was appointed to succeed him, and took the name of TAU-KWANG. His administration was attended with a continued succession of wars, insurrections, and troubles in one quarter or another of his vast dominions; though none of them threatened the overthrow of the government, until the war with England commenced in 1840. A rebellion in Turkestan, in 1828, was attended with great cruelty and treachery on the part of the Chinese; and its leader, Jehangir, was murdered in violation of the most solemn promises. An insurrection in Formosa, and a rising among the mountaineers of Kwangtung, in 1830-32, were put down more by money than by force; but as peace is both the end and evidence of good government in China, the authorities are not very particular how it is brought about. Still, so far as can be judged from the imperfect data of native historians of former days, compared with the observations of foreigners at present, there is little doubt that this enormous population has been as well governed under the Manchous as they were under the princes of the Ming dynasty.

In our next we have to enter upon the origin and history of the present insurrection in China, and the successful progress of Christianity.

INORGANIC CHEMISTRY.

CLASS III.—METALS OF THE EARTHS.

XXIII. ALUMINUM. AL.=13·69.

Aluminum is best obtained, like magnesium, by the action of sodium or potassium on its chloride. It is a gray powder, not easily melted, has a metallic lustre, and burns, when heated in the air, with a bright light, forming alumina.

Alumina; Sesquioxide of Aluminum; Al_2O_3.—Pure alumina is found crystallized in those precious gems, the oriental ruby and sapphire, which are next in hardness and value to the diamond. Emery is also nearly pure alumina. Alumina is an abundant ingredient in many other minerals, and forms a large part of many slaty rocks, from whose decomposition clays are produced.

Pure alumina is a fine white powder, not rough and gritty like silica. Mixed with water it forms a plastic mass, which has the well-known tenacious qualities of clay. It is the basis of the art of pottery. When alumina is precipitated from its solutions in acids by an alkali, it falls as a bulky, gelatinous, transparent hydrate, which shrinks very much on drying, and has three equivalents of water of composition at 100°, which are expelled by heat. The anhydrous alumina is almost insoluble in acids, while the hydrate is readily dissolved, forming salts of a peculiar astringent taste, familiarly known in common alum.

Alumina is precipitated as a hydrate from solution, by either potash, soda, or ammonia, and their carbonates; an excess of the two first will redissolve the precipitate. Hydrosulphuret of ammonia throws down alumina. The chloride of aluminum has no particular interest except as a means of procuring the metal.

Sulphate of Alumina, $Al_2O_3 3SO_3+18HO$.—This salt is prepared by saturating dilute sulphuric acid with alumina; it has a sweetish astringent taste, is soluble in two parts of water, and crystallizes in thin plates.

Alums.—Sulphate of alumina forms with potash, soda, and ammonia, double salts of much interest, called *alums.* They are all soluble salts, with a sweetish astringent taste, and crystallize in the regular system, or first class, usually as modified octahedrons, which have uniformly 24 equivalents of water of crystallization. Common potash-alum has the formula, $Al_2O_3,3SO_3+KO,SO_3+24HO$, it dissolves in 18 parts of cold water, and the solution has an acid reaction.

Alum and *Acetate of Alumina* are largely employed in the arts of dyeing and tanning. Alumina combines with colouring matters, and seems to form a bond of union between the fibre of the cloth and the colour. In this it is said to act the part of a *mordant.* When alum is added to the solution of a colouring matter, and the alumina is precipitated with an alkali, all the colouring matter is thrown down with it, and forms what is called *lake.* The common lake used in water-colouring is derived from madder treated in this way. Carmine is a lake made from cochineal.

Silicates of Alumina.—This is the most extensive and important class of the aluminous salts, and comprises a great number of interesting minerals. *Felspar* ($Al_2O_3, 3SiO_3+KO,SiO_3$), which is one of the chief components of granite and granitic rocks, is of this class, and has the composition of an anhydrous alum, the sulphuric acid being replaced by the silicic. *Kyanite* and *Sillimanite* are simple basic silicates of alumina. *Albite* is a salt having soda in place of the potash in felspar, while *spodumene* and *petalite* are similar compounds. with a portion of the soda replaced by *lithia.* Many other similarly constituted compounds are found among minerals, some of which are hydrous and others anhydrous, and varied by frequent substitution of peroxide of iron, or other isomorphous bases, for the alumina.

Pottery.—The decomposition of felspar and other aluminous minerals and rocks, gives origin to the *clays* which are so important in the art of pottery. Decomposed felspar forms *porcelain clay*, commonly called *kaolin.* The undecomposed mineral is often ground up to mix with the materials for porcelain. The felspar of Middletown, Ct., and Wilmington, Delaware, in America, is used in large quantities for this purpose.

The difference between porcelain and earthenware consists in the partial fusion of the materials of the former by the heat of the furnace, which gives it the semi-transparency and great beauty for which it is so highly prized. The glaze in porcelain is formed of a more fusible mixture of the same materials, put over the articles as a wash, after they have been once through the furnace (in which state they are called biscuit ware); they are then baked again at a heat which fuses the glaze, but which does not soften the body of the ware.

The painting of porcelain is an art requiring a refined knowledge of chemistry. All the colours used in this art are metallic oxides, which are put on after the ware has been once baked. The colours result from compounds formed by the metallic oxides with alumina by fusion, and do not appear until after the baking. Metallic gold is put on in the form of an oxide, and the steel lustre is produced by metallic platinum.

XXIV. GLUCINUM. XXV. YTTRIUM.
XXVI. ZIRCONIUM. XXVII. THORIUM.
XXVIII. CERIUM. XXIX. LANTANUM.

All these metals are so rare as to be known only to chemists. Their oxides occur in several minerals, nearly all of which are among the most uncommon specimens in mineralogical collections. *Glucina* (24), or the sesquioxide of glucinum (G_2O_3), is the most abundant, being found to the amount of 17 per cent. in the gems *beryl, emerald,* and *chrysoberyl.* It very much resembles alumina, and is named in allusion to the sweet taste of its salts. *Yttria* (25), the oxide of yttrium (YO), is a white earthy powder, forming sweetish salts, but differing from alumina and glucina in not being re-dissolved like them in an excess of potash and soda: this earth is found in the minerals *yttro-cerite, gadolinite,* and *yttro-tantalite. Zirconia* (26), sesquioxide of zirconium (Zr_2O_3), which is the earth of the zircon or hyacinth, much resembles alumina, but differs from it and from glucina, yttria, and thorina, by being precipitated from its solutions, as an insoluble sulphate, by boiling with solution of sulphate of potash. *Thorina* (27), the oxide of thorium, is found in only one or two very rare minerals, as in *thorite* and *monazite;* its specific gravity is 9, being much higher than any other earth. *Cerium* (28), and *Lantanum* (29). The oxides of these two rare metals are invariably associated with each other, and also with that of another metal, *didymium,* not yet fully described; they are found only in some very rare minerals, as *cerite, allanite, monazite,* &c. The oxide of cerium forms beautiful yellow salts, while the oxide of lantanum forms equally beautiful rosy compounds; the latter has been named in allusion to its having been long *concealed* or *hidden* under cerium, with which it is associated.

THE STUDY OF CHEMISTRY WITH THE BLOWPIPE.—No. I.

We are not surprised that Chemistry appears to the majority of young persons the most expensive and the most difficult of all sciences. The bulky volumes published on this subject, as text-books,—the variety of apparatus described as necessary or useful,—and the long list of compounds produced by proportional admixtures of elementary substances, alarm those who, without any professional object, desire to obtain some acquaintance with the nature and composition of inorganic bodies. That a study so interesting and useful should be thus misrepresented to an inquiring mind, and that curiosity should be repressed by a dread of difficulties, or the fear of failure, is often spoken of with regret; but attempts are not made to prove the error of the uninstructed, or to point out an easier road to elementary knowledge. Chemists know many safe and pleasant paths to the fields of science they cultivate; but their thought and time are too much occupied in other matters, to leave a spare hour for the instruction of the stranger. But the task is a pleasing one, and we will venture to point out a path which may be easily traced, and will yield many useful fruits to those who pursue it.

There are two ways in which chemical analysis may be performed—the one by the use of re-agents, and is called the wet way; the other is by the action of heat, and is commonly known as the dry way. By the former, we are able to determine the substances present in any compound, and their relative proportions. When a mineral is decomposed by heat, we detect the elementary bodies composing it, but can rarely ascertain their proportions. Analysis by re-agents is, on this account, preferable in many inquiries; but on the other hand, the blowpipe enables us to detect the presence of quantities too minute to be discovered by the other process. The blowpipe, for example, will detect the presence of copper in the ashes of a sheet of paper; silver in a grain or two of shot; and gold in the gilt bead of a lady's purse: results which could not be obtained by any other mode of analysis. But if this little instrument did not provide us with the means of performing such delicate researches, it would still be an invaluable assistant to the chemist and mineralogist, from its great portability, and the ease with which it may be employed. It is, however, chiefly as a means of instruction in the elementary facts of chemistry that we introduce it to our readers. A great variety of experiments may be performed with it, which will have, not only an interest as curious phenomena, but will explain the composition of many common or rare substances, and give a manipulative skill which will aid the student in other researches.

Although the blowpipe may appear an insignificant instrument, it is one of the most useful and important employed by the student of nature. Its construction is simple; but to use it expertly requires considerable practice. When this skill has been acquired, the manipulator will find it equal to his purpose, however large may be the range of his chemical knowledge. The task of separating the elements, composing the numerous compound bodies formed by nature and art, is frequently difficult, and in many cases the assistance of an adept is required to obtain the desired effect; but the ease with which such a person performs his experiments must act as an encouragement to the student.

The blowpipe, in its simplest, and perhaps best form, is a small copper or brass pipe, tapering to a point, and fitted with a mouth-piece of bone or ivory. In this form it is used by braziers, goldsmiths, and other artizans working in metal. For such purposes it was employed long before it was adopted by the chemist. Bergman says that Andrew Swab, a Swedish metallurgist, and a counsellor of the College of Mines, was the first who applied the blowpipe to chemical analysis, about the year 1733; but as he has left no record of his experiments, it is impossible to determine the extent of his researches. Cronstedt, whose uncommon genius made him unintelligible to his contemporaries, also used the blowpipe in the investigation of chemical substances. By observing the phenomena produced by the action of fusible re-agents on compound bodies, he discovered their constitution, and attempted a classification of minerals. To this chemist we are undoubtedly indebted for the introduction of the blowpipe as an instrument of analysis; but the scientific men of his day had so great a dread of all innovations in the ordinary modes of thinking and established practice, that he was at first afraid to publish more than the results of his experiments, and did not acknowledge himself to be the author of the "New System of Mineralogy." Cronstedt's researches were made known in this country through an English translation, published by Von Engestiom, who added to it a "Treatise on the Blowpipe," in which he describes the various processes at that time employed, and analyses of the most important minerals. This work soon attracted the attention of the most eminent chemists and mineralogists, and the blowpipe was soon after adopted in every laboratory—with what advantage, is perhaps doubtful, for, in consequence of their want of skill, and a still greater lack of perseverance, there were few who employed it for any other purpose than to determine the fusibility of inorganic substances with borax.

Bergman, whom we have already mentioned as an author on the subject, was singularly expert in the use of the blowpipe, and extended its application to almost every branch of inorganic Chemistry. It was he who first used it successfully for the discovery of minute particles of the metals. But the mental energy and enthusiasm of this eminent investigator were not sustained by his physical strength—he desired to do more than his health permitted. That the researches he had devised might not be impeded by the weakness of his body, he resolved to obtain the assistance of some manipulist on whom he could depend; and with this object he sought Gahn, and induced him to pursue the investigations he was unable to complete, suggesting to him, as a task worthy the performance, the examination, by the blowpipe, of all the then known minerals. The constant pursuit of mineralogical analysis gave Gahn so much expertness in the use of the instrument, and such a thorough acquaintance with the character and composition of inorganic substances, that he was able to detect the smallest proportion of a metal in any compound. Soon after the discovery of the oxide of Columbium, Ekeberg sent him a small specimen, and asked him to analyse it; he immediately announced that it contained tin, though the proportion of that metal in the mineral is not more than one part in one hundred. "Long before the question was started, whether the ashes of vegetables contain copper, I have seen him," says Berzelius, "extract with the blowpipe, from a quarter of a sheet of burnt paper, distinct particles of metallic copper."

The blowpipe commonly employed in the arts consists of a tapering brass tube, about thirteen inches long, three-eighths of an inch diameter at the larger end, and one-sixteenth of an inch at the smaller (Fig 1.) Within about an inch of the point, it is bent at nearly a right angle. The mode of using this instrument is evident. The larger end being put into the mouth, the flame is directed by a stream of air passing through the tube, from the lungs, upon the substance to be heated. In the arts it is seldom necessary to continue the blast for more than a minute at a time. Little or no inconvenience therefore arises from the condensation of the vapour of the breath. But in chemical research it is often necessary to produce a continuous current of air for a much longer period, and the deposition of moisture then becomes seriously inconvenient. Cronstedt suggested the introduction of a small hollow globe or ball, about the centre of the instrument (Fig. 2), to collect the condensed vapour. This device answers very well so long as the instrument is held in a horizontal position; but when it is inclined towards the vertical, with the small end downward, the condensed vapour flows through the tube, and is driven by the blast of air into the flame, and upon the subject of experiment. To remedy this inconvenience, Mr. Pepys suggested the propriety of making the larger end of the beak project into the ball, as shown by the doted lines in the diagram. Other changes have been made in the construction of the instrument, to suit the taste or convenience of experimentalists; but these it is not necessary to explain.

Fig. 1.

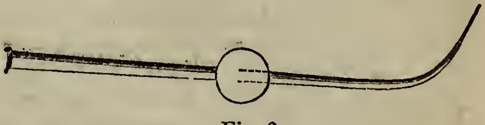

Fig. 2.

Blowpipes are usually made of either tin, brass, or silver. Brass is preferable to tin, and, being less expensive than silver, is generally selected. It serves every purpose when well lacquered, and fitted with an ivory mouth-piece. Two or three jets of different sized apertures are provided, to give the opportunity of adapting the flame to the object required.

As the use of the blowpipe is to direct the flame of some combustible body upon a substance to be heated, it is necessary to ascertain what combustible is best suited for the purpose. Wax and tallow candles may be used for the production of the necessary flame; but the heat radiated from the substance under experiment, and that which supports it, frequently melts them. The candles sometimes used in carriage-lamps are better suited to the purpose than any other; for the tallow is hard, and the wicks are sufficiently large to give a good flame. Whatever candle is used, the experimentalist must be careful not to have the wick two short; and at the same time to prevent the formation of any incombustible carbonaceous ash.

In many cases, if not all, lamps are better than candles. The spirit of wine is, for many reasons, the best material. Lamps supplied with this substance are very cleanly, require no trimming, and are readily re-lighted. The principal objection to the spirit-lamp is the expense of the spirit of wine; and as pyroligneous ether is cheaper, it is often preferred, though it emits a disagreeable odour. Oil-lamps, however, are still more frequently used. The best oil for the purpose, according to Berzelius, is the olive. Faraday prefers tallow or dripping, as it gives the most intense heat.

The construction of the lamp is of some importance, if it be only in reference to the convenience of the manipulator; but a little practice will suggest the alterations most suitable to the purposes for which he requires it. He will, perhaps, find it convenient to have a rest for the beak of the blowpipe, both to steady the instrument, and to enable him to disengage his hand from the instrument when necessary, without diminishing the intensity, or altering the direction, of the blast.

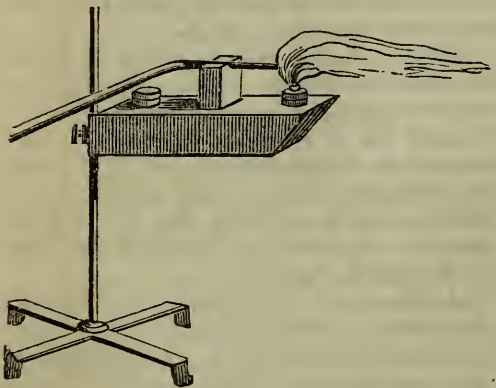

Fig. 3.

No one must expect to use the blowpipe with good effect when he makes his first essay. A person who has command of the instrument can, at pleasure, produce three different effects—oxidation, reduction, and fusion; and to obtain this skill will be the student's first effort. To understand how these several results are obtained, it is necessary to examine carefully the construction of a flame. The shape of the flame of a candle is, as every one must know, a vertical cone; the apex upward and the base downward. A more attentive examination of it than is usually given, proves it to consist of a series of vertical cones, one within the other. Examining it from its base upwards, there will be observed an external flame, or envelope of a dark blue colour (*c*, Fig. 4), which gets thinner as it is farther removed from the wick, and disappears at the point where the external surface of the flame ascends perpendicularly. In the centre of the flame, immediately surrounding the wick, a dark mass of inflammable vapour (*a*) will be observed, but not in combustion, from the want of atmospheric air. Exterior to this, there is a bright, luminous flame (*b*), consisting of the same vapours in combustion, surrounded by a less luminous volume of matter, the greatest thickness of which is near the summit of the brilliant flame. On this point the heat is most intense, for the gases evolved are in complete combustion. If a current of air be thrown into the middle of the flame, by means of a blowpipe, a long narrow blue flame will appear to issue from the point of the jet. This flame is of the same character, and in the same state, as the blue flame of the candle; but its relative position is changed; for instead of being external, it is concentrated, and forms a small pointed conical cylinder. The greatest heat is at the extremity of this blue flame; and bodies, upon which it would have no visible effect when quietly consuming in a candle, are in some cases fused, and in others vapourised. At a short distance from this point, reduction is most easily

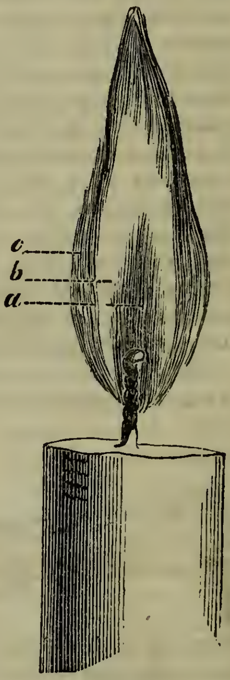

Fig. 4.

and rapidly effected. The portion of the bright flame which surrounds the blue prevents the loss of heat during fusion or reduction, and at the same time aids the oxidation of bodies.

There is much to be learned which cannot be taught in every art. Experiment in all such cases is the best master. The student, however, may find one or more of the following hints useful, in the absence of a practical teacher. To learn the use of the blowpipe, it is necessary to put oneself under a sort of drilling, and to learn one step at a time. The first operation is to distend the cheeks with air, and breathe through the nostrils. When the habit of doing this has been obtained, an effort must be made to force a current of air through a blowpipe upon the flame of a candle, so as to produce a steady, unbroken flame while respiration is supported. This is done during inspiration by compressing the air in the mouth by the muscular contraction of the cheeks. The difficulty is to replace by inspiration the air forced from the mouth during respiration, at the same time supporting the blast of the blowpipe.

The student must next endeavour to obtain the art of oxidising and reducing mineral substances. Oxidation is readily effected, and it is only necessary to state that the farther the body is from the flame, provided a sufficient heat be maintained, the more readily will oxidation be produced. An incipient red heat is best adapted for the purpose.

To reduce a metallic compound requires a much finer jet than to oxidize at. A little beyond the point of the blue flame (*c*, fig. 5), just at the commencement of the brilliant part (*b*), reduction is most easily produced. The reduction is completed by surrounding the oxide with an atmosphere which has undergone only an imperfect combustion, and therefore carries away the oxygen of the oxide. "A very advantageous mode of practice, in order to acquire the art of making a good reducing flame, is," says Berzelius, "to fuse a small grain of tin, and raise it to a reddish-white heat on a piece of charcoal, so that its surface may always retain its metallic brilliancy. Tin has so great a tendency to oxidation, that the moment the flame begins to become an oxidating one, it is converted into an oxide of tin, which covers the metal with an infusible crust. We must begin by operating on a very small grain, and gradually proceed to larger and larger. The greater the quantity of tin that can be kept in the metallic state at a high temperature, the more expert is the operator."

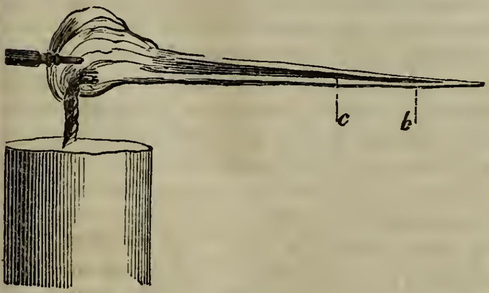

Fig. 5.

The substance upon which the flame of the blowpipe acts, is called the assay. To expose it conveniently to the flame, a support of some kind is necessary. Its form and composition must be selected according to the experiment to be performed. Charcoal and platina are the most useful substances for this purpose. A support should be as bad a conductor of heat as possible, that the operator may hold it without inconvenience, and that the heat may not be carried off from the assay. This negative property gives to charcoal and platina their value as substances well adapted for use in the construction of supports for assays. The charcoal should be of that kind which does not crackle or scintillate when exposed to an intense heat, for it may otherwise scatter the assay, and endanger the eyes of the operator. The charcoal prepared from good boxwood is superior to any other. But from whatever wood the charcoal is made it must be well burnt, or it will split, smoke, or burn with a flame, and be utterly unfit for experiment with the blowpipe. When this substance is used, a small cup is made in it with the point of a penknife to receive the assay.

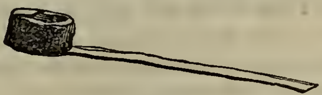

Fig. 6.

(*To be continued.*)

THE MONTHS.—OCTOBER.

(*Continued from p.* 180.)

For such as delight in autumnal scenery, there are nice rambles during this month; but Flora has not lavished her beauties upon the earth to tempt us abroad; therefore we shall enjoy the flowers she scatters into the lap of summer with greater pleasure. Beautiful, most beautiful is the language the heart has given to these fair children of the forest and field—bright and living links to bind the heart to Nature, and lift it to Him whose hand makes our earth so fair. As the scent from some favourite blossom steals over our senses, how magic is its power to recall the lost, the absent, in scenes of home and happiness, to which the weary spirit takes wing, and, flitting over past years of sorrow, lights on some bright spot of memory, conjuring up voices and smiles now silent for us, and, freeing the aching mind from the trammels of the world, reposes like a ray of light upon the green sward. For childhood's simple pleasures, what is so meet as flowers? As offerings of affection, none are so dear. Do they not league, in their sweet language, looks and tones—that the heart will alone besides record?

Garden Flowers.—The cold breezes of October are blowing through the shrubs, and making many a flower and bough bend beneath its force. We must not stay long in the garden, for the paths are damp, and there are not many flowers to entice us to ramble abroad. Here is the late feverfew (*Pyrethrum serotinum*), the common double feverfew (*P. parthenium*), with its unpleasant odour and ornamental white flower. There is also the garden gold flower (*Chrysanthemum coronarium*); the Chinese chrysanthemum (*C. Sinense*), so frequently called pyrethrum; the parrot corn-flag (*Gladiolus psittacinus*); the sweet mignonette (*Reseda odorata*), which diffuses its odour with greater power at the rising and setting of the sun than at noon, and is a universal favourite with the ladies, as it signifies, in the language of Flora, "your qualities surpass your charms;" the tree mignonette (*R. odorata frutescens*); the sweet maudlin (*Achillea ageratum*); the scarlet sage (*Salvia fulgens*); the spotted honeywort (*Cerintha maculata*); and the beautiful aster (*Aster pulcherrimus*).

Wild Flowers.—Let us search for wild flowers in yon wood, where the quivering trees are showering their leaves upon the lone path we have so often passed over during the summer months. Listen to the rills that trickle down the moss-clad banks on either side of us; and hark! how the sound of the rustling leaves mingles with the constant twitter of the birds as they hop from branch to branch, and congregate previous to their departure for other climes.

Here is the round-leaved pyrola, or winter-green (*Pyrola rotundifolia*), which is somewhat rare in England, though in Scotland it is frequently found in some parts. You observe that it grows in a moist place, as all the winter-greens do, for they delight in moist, shady places, with a loose sandy soil. They derive their name from their leaves retaining their colour: hence their name of winter-green in various languages—thus, *Wintergrün*, in German; *Das Winteryrün*, in Dutch; *Wintergroen*, in Danish; and *Vintergrön*, in Swedish. The medicinal species (*Pyrola Umbellata*) is found in several parts of Europe, Asia, and particularly America. It seldom exceeds eight inches in height, and has pretty flowers—white, tipped with rose—with an agreeable aromatic odour. Although the winter-green is admitted into our pharmacopœia, it has been much neglected, and undeservedly, for it is an admirable tonic and diuretic, increasing the appetite, and acting powerfully on the kidneys; and as its taste is rather pleasant, it forms a valuable medicine for children.

How beautiful the various kinds of bear-berry look. Observe how the deep rose-coloured blossoms of the red species (*Arbutus uva ursi*) contrast with the mass of ivy (*Hedera helix*) that covers the wall at the end of this path, and with the strawberry tree (*A. unedo*), with its greenish-white flowers; and the black bear-berry (*A. alpina*) with its bright crimson foliage.

Do you observe that plant with yellow, star-shaped flowers, growing in clusters on a stem, nearly a yard high? It is the shepherd's spikenard (*Conyza squarrosa*), which is much prized by cottagers.

There are few wild flowers to delight us this month with their loveliness and perfume; for

> "Fruits, not blossoms, form the woodland wreath
> That circles autumn's brow."

A few mosses clothe the trunks of trees, banks, and walls, affording a retreat for many a tiny insect, and a soft material to line the nests of the birds. Few would imagine that upwards of 800 kinds of mosses have been discovered, each of which possess distinct characters.

Do not let us pass by these old trees and rocks covered with lichen patches, for lichens perform an important part in the economy of Nature, by preparing the surface of the earth for other plants, and in furnishing materials useful in the arts and medicine.

Among the birds we may observe the wood-pigeon (*Columba palumbus*); the merlin (*Falco Æsalon*); the shoveller (*Spathulca clypeata*); the woodcock (*Scolopax rusticola*); the teal (*Querquedula crecca*); the hooded-crow (*Corvus cornix*); the redwing (*Turdus iliacus*); and the gray-leg goose (*Anser palustris*), arriving from the north. Many birds depart for the southern latitudes, among which we may include the sand-piper (*Totanus hypoleucos*); the red-shank (*T. calidris*); the fly-catcher (*Muscicapa grisola*); the hobby (*Falco subbuteo*); the hawk-owl (*Strix hudsonia*); the window-swallow (*Hirundo urbica*); the bank-swallow (*H. riparia*); and the land-rail (*Ortygometra crex*).

As salmon (*Salmo salus*) and phinocks (*S. albus*) spawn this month, they do not afford sport for the angler, but he may be able to amuse himself by trolling and bottom-fishing for roach (*Leuciscus rutilus*), and chub (*L. cephalus*), because this month is not good for fly-fishing or angling in still water.

The entomologist will have little outdoor work this month, and therefore, on wet and unfavourable days, he should employ his time by arranging, cleaning, and mounting the specimens obtained during the summer months. Perseverance will accomplish much, and therefore it behoves him to be abroad early and late, in order to obtain good specimens. Let him search diligently for moths and butterflies, and he will no doubt capture some of the following varieties—The red admiral butterfly (*Vanessa Atalanta*); the peacock butterfly (*V. Io*); the small copper butterfly (*Lycana phlœas*); and the painted lady butterfly (*Cynthia Cardui*). A few moths may be captured, but they are not common, particularly the hornet-sphinx moth (*Ægeria crabroniformis*); the plumed moth (*Pterophorus pterodactylus*); and the parrot carpet moth (*Euthalia psittacata*).

The quadrupeds of the month are the Alpine hare (*Lepus variabilis*), and the field-mouse (*Mus sylvaticus*); the straw-mouse (*Sorex araneus*), and the vale-mouse (*Arvicola agrestis*), which prepare their nests for the winter.

The reptiles are the viper (*Vipera communis*); the snake (*Natrix torquata*); the toad (*Bufo communis*); and the tortoise (*Testudo Græca*), which conceal themselves in holes, or in the earth.

◆

A QUERY.

Two boys amusing themselves at "snatch-apple," in a room thirteen feet high, find that by standing twelve feet from each other, the apple, which is suspended from the ceiling by a string, and in a right line between them, when put in motion, just touches each of their watery mouths. Required the area of the section described by the string and apple; the perpendicular height of each boy's mouth from the ground being five feet?

◆

LESSONS IN FRENCH.

PRONOUNS.

Repetition of the Adjective Possessive Pronoun.—The possessive adjective pronoun indicating the same views of the mind in reference to the noun as the article does, with only an additional idea of possession, those two parts of speech should follow the same rules in most cases; and we might, perhaps, dispense with the repetition of those rules here; but as foreigners cannot hear too often the same principles, especially when they differ with those of their own language in cases of similar nature, we will repeat, for the possessive pronouns, what we have already explained, in speaking of the article.

Of the Repetition of the Possessive Pronouns with two Nouns united by the Conjunction And, et.—Whenever the possessive pronouns are used with several nouns in the singular, united by the conjunction *and*, expressed or understood, these pronouns should be repeated before each noun;

but when the nouns are in the plural, although they are generally repeated, there are many cases in which usage allows that they should be used but once; as in, He hath the same faults as his father and mother, Il a les mêmes défauts que *son* père et *sa* mère. Resemble your fathers and mothers, and be, as they were, a blessing for your country, Ressemblez à *vos pères* et *mères,* et soyez, comme eux, la bénédiction de votre pays. Children resemble to some extent their fathers and mothers, Les enfants ont des resemblances avec *leurs* pères et *leurs* mères. Although usage authorizes the omission of the pronoun, as may be seen by the above examples, it is better that foreigners should not avail themselves of this privilege, for it is difficult for them to ascertain when they may use it with propriety or not.

Of the Repetition of the Possessive Pronoun with Two Nouns united by the Conjunction Or, ou.—Whenever two nouns, united by the conjunction *or, ou,* represent objects of a different nature, the possessive pronoun should be repeated before the second; but if the second noun is only used to explain the meaning of the first, the repetition of the pronoun is not necessary; as in, You shall not leave this place without giving me your money or your clothes, Vous ne sortirez pas d'ici sans me donner *votre argent ou vos habits.* The Indians and the Jews are much attached to their castes or tribes, Les Indiens et les Juifs sont très attachés à *leurs castes ou tribus. Money* and *clothes* are two different things, but *castes* and *tribes* are synonymous.

Of the Repetition of the Possessive Pronouns with Two Adjectives united by the Conjunction And, et.—Whenever two adjectives, united by the conjunction *and, et,* are used to qualify the same noun, the possessive pronoun is not repeated; but if the two adjectives qualify two nouns, one being expressed, and the other understood, the pronoun should be repeated before each; although, if the two adjectives are placed after the noun, the repetition ought not to take place; as in, Farewell, my good and worthy friend; be of good courage, and think sometimes of me: Adieu, *mon bon et digne ami;* ne perdez pas courage, et pensez quelquefois à moi. Every man has his good and evil genius, Chaque homme a *son bon et son mauvais génie.* She has been placed on earth to share my good and evil fortune, Elle a été mise sur la terre pour partager *ma fortune bonne et mauvaise.* The last sentence is grammatical, but it would be better to say:—Elle a été mise sur la terre pour partager *ma bonne* et *ma mauvaise fortune.* In the first sentence there is but one friend spoken of,—he was good and worthy: in the second, there are two genii, one good, the other bad; hence the repetition of the pronoun before the second adjective.

Of the Repetition of the Possessive Pronoun with Two Adjectives united by the Conjunction Or, ou.—Whenever two adjectives, united by the conjunction *or, ou,* are not synonymous, the pronoun is repeated before the last; unless the two adjectives should be placed after the noun, in which case the pronoun is never repeated; as in, We shall all be judged according to our good or bad actions, Chacun de nous sera jugé selon *ses bonnes ou ses mauvaises actions.* Every village has now its own history, either true or false: Chaque village a maintenant son histoire, *vraie ou fausse.*

Of the Possessive Pronouns of the First Person Singular, with the Nouns Father, Mother, &c.—Whenever the nouns, *father, mother, sister, brother, uncle, aunt, child, friend,* or any others of a similar nature, are used in an apostrophe, or in speaking of our own relatives, they are preceded, in French, by the possessive pronouns *mon, ma, mes,* although these pronouns are omitted in English; as in, Good morning, father; how is mother to-day? Bon jour, *mon père;* comment se porte *ma mère,* or *maman,* ce matin? Come, children, let us go and take a walk, Venez, *mes enfants,* allons nous promener. Father, have you seen aunt Lucy to-day? *Mon père,* avez-vous vu *ma tante* Lucie aujourdhui? Although a person should address children who are not his own, it is a matter of kindness to use the pronoun *my,* in French; as in, Well, children, how is your father this afternoon? Eh bien! *mes enfants,* comment se trouve votre père aujourdhui ?

Of the difference existing between the Personal Pronoun leur, *meaning* to them, *and the Possessive Pronoun* leur, *meaning* their.—The personal pronoun *leur,* used for *to them,* should not be mistaken for the possessive pronoun *leur*, meaning *their*; for the former never takes the sign of the plural, whilst the latter agrees in number and gender with the noun which it precedes; as in, Do not speak to them of my affairs, Ne *leur* parlez pas de mes affaires. They have sold their horses and carriages, Ils ont vendu *leurs chevaux* et *leurs voitures.*

Of the Possessive Pronouns used in English before Nouns expressing a part of the Body, or anything belonging to our Moral or Physical Constitution.—Whenever any of the possessive pronouns is used before a noun expressing a part of our body, or anything which belongs to our moral or physical constitution, or when we speak of an object or person which is so designated by the verb, or the sense of the sentence, as not to leave any ambiguity in regard to the owner of what is spoken of, the genius of the language requires that the article *the* should be used in French, instead of the English pronoun. This peculiarity of the French language gives rise to the three following rules:—

Of Cases in which the Article The *alone should be used in French instead of the English Possessive Pronoun, before Nouns the signification of which has been explained in the preceding chapter.*—Whenever by using the article *the* alone, before such nouns as have been designated in the preceding chapter, no ambiguity arises in the sentence, it should be invariably employed in French, instead of the English possessive pronoun; as in, I have lost my voice, J'ai perdu *la voix.* He lost his life, Il a perdu *la vie.* My head aches (or, I have a pain in my head), J'ai mal *à la tête.* I have a sore throat (or, I have a pain in my throat), J'ai mal *à la gorge.* Your daughter tells a falsehood whenever she opens her mouth, Votre fille dit un mensonge toutes les fois qu'elle ouvre *la bouche.* These sentences are perfectly clear with the article; for nobody can lose any other voice or life than his own; no one can have a pain in any other head or throat than his; a person cannot open any other mouth than his own, in order to tell a lie. But if the nouns expressing a part of our body, or any of our faculties, were qualified by an adjective, the possessive pronouns should be used in French as they are in English; as in, She raised her white hands to heaven, Elle leva *ses blanches mains* vers le ciel. I have lost my fine voice, J'ai perdu *ma belle voix.* What is the matter with your little foot? Qu'avez-vous à *votre petit pied?*

Of cases in which ambiguity would arise in the sentence by using the Article The *alone, instead of the English Possessive Pronoun.*—If an ambiguity should arise in a sentence by using the article *the* alone, as clearness is the first condition of good language, that ambiguity should be remedied in some way; for that purpose, an objective pronoun is used with the verb, to show distinctly what is the body to which the part spoken of belongs; as in, He hath broken his arm (he to himself has broken the arm), Il *s'*est cassé *le bras.* Do not press my hand so much (do not to me press the hand so much), Ne *me* pressez pas tant *la main*, Thank God for having saved your life (thank God for having saved to you the life), Remerciez Dieu de *vous* avoir sauvé *la vie.* It will be necessary to cut off your leg, if they wish to save your life (it will be necessary to cut off the leg to you, if they wish to save the life to you), Il faudra qu'on *vous* coupe *la jambe,* si l'on veut *vous* sauver *la vie.*

Of cases in which the Possessive Pronoun, being used with a Noun followed by a relative Pronoun, is expressed in French by the Article.—Whenever a possessive pronoun is used in English with a noun preceding a relative pronoun, which is itself followed by a nominative pronoun of the same person as the possessive, this possessive pronoun is expressed, in French, by the article; as in, Give me my pocket-book that I bought in New York, Donnez-moi *le* portefeuille *que j'*ai acheté à New York. How do you like your carriage which you have received from France? Comment trouvez-vous *la* voiture *que vous* avez fait venir de France? Where have you put my stockings that I mended this morning? Où avez-vous mis *les* bas *que j'*ai raccommodés ce matin? Although sentences constructed in this way do not always appear sufficiently clear, the language does not admit of any other construction; and if the person spoken to should be in doubt, as might be the case in the first and last sentences, about the thing spoken of, that doubt would cease by his asking, Which pocket-book? What stockings?

EDUCATIONAL AND SCHOLASTIC MATTERS.

LONDON CENTRAL DISTRICT SCHOOLS.

An important inquiry has recently been making into the working of these schools, from which it appears that many abuses have been discovered, especially in the central schools at Norwood. From the report of the committee appointed to investigate the matter, we learn that—"The district schools at Norwood were established in 1845—a purchase of the premises of Mr. Aubin having been effected at a cost of £10,000, including the furniture, machinery, fittings, &c. The land in this purchase consisted of 1¾ acre freehold, and 2¾ acres leasehold; three-fourths of an acre adjoining was subsequently acquired at a cost of £1,650, including some small cottages thereon; 1¼ acre in the rear has also been bought for the erection of a chapel, for the sum of £1,300, being at the rate of about £1,000 per acre. The total quantity of land purchased being 3¾ acres freehold and 4 acres leasehold; in addition to which 40 acres are rented of Dulwich College and others." The report then proceeds to state that the freehold land was thus acquired at a sum quite inconsistent with the value of land in the vicinity, without any corresponding advantage. The North Surrey School were enabled to purchase a site for their establishment in the immediate neighbourhood of these schools, at £70 per acre, whilst the cost of land for the London Central District Schools averages £1,000 per acre. The committee then proceed to recommend that every effort be adopted to accomplish the removal of the schools to some locality more suitable for the purpose of training and educating the children, because, in the first place, the erection of the Crystal Palace so contiguous to the school, has, for many reasons, rendered the present site ineligible for the purposes of education of pauper children; secondly, because the schools themselves are not capable of suitable or effective arrangements; and thirdly, because the present opportunity is peculiarly favourable for the disposal of the land and premises on advantageous terms.

NATIONAL SCHOOLS AT YARMOUTH.

This important fishing town having been long destitute of the advantages of popular education, we rejoice to perceive that within the last two or three years, most important strides have been made in making educational provision for the humbler classes. In 1850, by the exertions of the spirited incumbent of Yarmouth (the Rev. Canon Hills), the St. Peter's National Schools were erected, by the aid of grants from the National Society and the Committee of Council on Education. The building is not only neat but ornamental in appearance. It is faced with flint, having stone dressings and buttresses, and is fronted with iron palisades. All the rooms are large, lofty, and airy. The centre room is appropriated to the infants, the right wing to the girls, and the left to the boys. There are now 200 boys, 150 girls, and 150 infants, in all 500 children, receiving daily education in these schools at a very trifling cost to their parents. The master of the boys' school is assisted by four, and the mistresses of the girls' and infants' schools each by two pupil teachers. Mr. Harding, who was trained at Battersea and holds a government certificate, is master of the boys' school; these schools are, of course, under government inspection. In 1852, the Priory National Schools were also erected at a cost of upwards of £3000. They are now the principal elementary schools of the locality; and afford accommodation for 750 children—namely, 350 boys, 200 girls, and 200 infants. The buildings are extremely handsome, both inside and out. They are built upon the site, and in great measure out of the remains, of an old Benedictine priory, close to the fine old parish church of St. Nicholas.

LIVERPOOL ROMAN CATHOLIC INSTITUTE.

This is a new Gothic building, which has been raised in the garden of the conventual scholastic establishment in Hope Street, for the use of the members of the Roman Catholic Institute, and formerly inaugurated by Dr. Wiseman. The building, which has a high-pitched roof, consists mainly of a lecture-hall, chancelled at the south-end, and beneath which are school-rooms for the education of boys, of whom there are at present 130 on the rolls. The lecture-hall is 75 feet by 25 feet in size, 30 feet high, and is capable of accommodating about 500 persons. The chancelled portion of the hall forms a small chapel, 23 feet by 13 feet, at the east end of which is a small sacristy. The style is of the decorated period, the remainder of the building being of plain domestic character.

SCHOOL DIETARY.

Mr. M. Mitchell, H. M.'s Inspector of Schools, has written the following letter, on the deficiency of the dietary in schools abroad:—

"Having only just returned from Switzerland, where I met accidentally with a youth who attends the Cantonal School at Zurich, I am enabled positively to state that the diet of the house he boards at is likely to prove very detrimental to his constitution; consisting as it does of broths and vegetables mostly, and the meat such as is allowed being totally unlike anything we call either beef or mutton.

"I met also a gentleman who was at a school at Wisbaden, and who told me the effect was such as he is positive he never shall recover.

"The dietary produced, in himself and brother, cold night sweats, which continued with most weakening effects during the whole period of their residence abroad. There are, doubtless, many advantages to be derived from sending youths abroad for instruction, especially in languages; but these, it seems to me, may be procured at too great an expense, if the health and strength of the boy be permanently injured by bad or deficient feeding."

THE ANTIQUITIES OF NINEVEH, AND THEIR MYTHOLOGICAL CHARACTER.

The mysterious figures from Nineveh, which have been lately arranged in the new hall of the British Museum, consisting of winged lions, bulls, and other symbolical figures, have excited much curiosity as to their historical or mythological meaning; and on this subject an interesting paper was recently read before the Royal Asiatic Society, by Mr. E. C. Ravenshaw.—"A cursory examination is sufficient to satisfy the observer that they are not mere architectural ornaments, but symbols of certain mysteries and ceremonies of the primeval religion of Assyria. The chief mythological figures are the winged bull with a man's face, the winged lion with a man's face, the winged man with a fir cone in one hand, and a square basket or vessel in the other, and a man with the head and wings of an eagle or hawk. The hypothesis which the writer maintains with respect to them is, that they are, as already surmised by Mr. Layard, the originals of the cherubim of Ezekiel; that they were likewise the originals of the apocalyptic beasts of St. John; and that, slightly modified, they were afterwards adopted, and are now used, as the symbols of the Four Evangelists. Further, that they were originally invented by the Magi and Chaldeans as astronomical symbols of the equinoctial and solstitial points; that they represent in fact the four seasons—spring, summer, autumn, and winter: and perhaps also the four winds and the four elements. In support and illustration of these views, the writer enters into an examination of the passages in the Old Testament and in other writings, regarding the cherubim, showing that there is no authority in Scripture for supposing them to be bodiless infants, and comes to the conclusion that the face of a cherub was in reality the face of a bull. At an early period of the Christian Church, these winged animals were adopted as the symbols of the four Evangelists. The winged lion was assigned to St. Mark, as the symbol of strength; the winged ox to St. Luke, as the symbol of sacrifice; the eagle and chalice to St. John, as the symbol of contemplation; and the winged man with a cup and hatchet, to St. Matthew, as the symbol of power. The employment of these figures as astronomical symbols formed the next branch of inquiry, and the conclusions were that the colossal bulls are symbols of the sun in Taurus, or the vernal equinox; that the winged man is Mitra or Serosh, the guardian of the autumnal equinox; and the winged man-lion, and the eagle-headed man the symbols of the solstices, being the four cherubim who watched the gates of heaven, and upheld the zodiac.

THE HIGHWAYS OF PEACEFUL COMMERCE HAVE BEEN THE HIGHWAYS OF ART.

This is the title of an address, delivered at Liverpool, on August the 30th, 1853, by Cardinal Wiseman, on the occasion of the opening of the Catholic Institute. The Cardinal enforces the position of his title with an ample and detailed knowledge of the subject, and with an effective eloquence, which is here exercised upon art not for the first time. He negatives the notion that art ever followed in the track of war; traces that of Greece, and its enduring type, not, as has hitherto been popularly done, from an Egyptian origin, but from the Assyrian monuments, with which the Greeks were brought into acquaintance by commerce; the Etruscan, similarly from commerce with Greece; the modern Italian through Venice, from commerce with the Byzantine empire. "The great cities of Italy, at the very time when their arts most flourished, were the most enterprising in their commerce, but at the same time were manufacturing states. It has been shrewdly remarked, that Tyre, for many ages the greatest commercial city of the world, perished entirely, because it had not a productive, but merely a transit trade." Hence the application to manufacturing England is obvious, and pregnant of suggestion for our Schools of Design.

MUNIFICENT BEQUESTS TO PUBLIC SCHOOLS.

The late Richard Sawrey Cox, Esq., of London, bequeathed the following sums to the scholastic institutions of his native city of Coventry, free of legacy duty:—To the Girls' Blue Coat School, £1,500; to Fairfax's School, £1,000; to Bayley's School, £1,000; to the Bablake Boys' Charity, £500; besides £1,500 to the public hospital. The Coventry "Herald" states that these are the largest bequests to the Coventry charities since the middle of the 16th century.

EDUCATION IN SOUTH AUSTRALIA.

We rejoice to learn that South Australia, amidst all her accumulating prosperity, is attentive to the interests of education and intellectual progress. According to the last report of the central board of education, for the quarter ending the 31st of March last, there has been a progressive and considerable increase both of schools and of children attending them. In the month of March there were 90 schools, and 4579 children; the total increase on the quarter being 21 schools, and 1296 children. Of these 1296, 402 attended schools which were in existence the previous quarter. Of the said 90 schools, 32 are town, 13 suburban, and 45 country schools.

THE EDITOR AND HIS CORRESPONDENTS.

The "Family Tutor."—We beg respectfully to inform our correspondents that all communications for the Editor should be addressed to the firm of "Messrs. Wm. S. Orr & Co., Amen Corner, Paternoster Row:" where the Family Tutor is exclusively published.

L. M. N.—The work on "British Plants" cannot possibly be completed with the present volume of the Tutor; because, as it is intended to form a standard authority in botanical science, it must necessarily be on an extended scale, and the exact period of its completion cannot now be stated with certainty.

T. Mollard.—We feel obliged by your suggestions. There are many objects of practical interest to mechanical students, which, in due course, we shall not fail to introduce. The *slide* (or *sliding*) *rule* is assuredly one of these; but, as Mr. Mollard observes, "scarcely one out of twenty knows how to work it, and apply it to his business." We shall certainly endeavour, ere long, to obviate this evil.

J. P. must obtain the instructions of some practical man. Electrotyping has become a mechanical pursuit, which requires the greatest care in the manipulating process.

N. B.—A *Glass Barometer-tube* can only be bent by a strong degree of heat.

R. H. Moreton.—We know of no better work on Galvanism, in a cheap form, than Dr. Lardner's Treatise, which forms a part of his Encyclopædia.

Arithmeticus asks what may be considered a perfect number?—A perfect number is that which is equal to all its aliquot parts added together. According to this definition, 6 is a perfect number, because, if you take its aliquot parts, which are 1, 2, 3, their sum will be equal to 6; again 28 is a perfect number, because its aliquot parts, 1, 2, 4, 7, 14, added together, make 28. Now if you will find as many of them as you please, take the following progression, 1, 2, 4, 8, 16, 32, &c., which it is easy to continue in doubling every last term. Choose in this progression any one term; subtract unity from it; if the remainder is a prime number, multiply this remainder by the term; immediately preceding, the product will be a perfect number; but if the remainder is no prime number, you must choose another term. This rule will be made clear by some instances; take the term 4, subtract unity from it, the remainder is 3, which being multiplied by the term immediately proceeding—viz. 2, the product 6 is a perfect number; again, take the term 8, subtract unity from it, the remainder is 7; multiply this remainder by 4, the product is 28, which is a perfect number. But if you would take 16, because, having taken unity from 16, the remainder, 15, is no prime number, the product of 15 by 8 will not be a perfect number; therefore take the following term, 32, and working as is prescribed, you will find 496 for another perfect number.

Academy—A Pupil.—Academy, in its original sense, was simply applied to the house of a certain Athenian nobleman named Academus, situated near the walls of the university of Athens, to which he invited men of learning. It was honoured by Plato and others, who resorted thither to hold private philosophical conferences. Cicero likewise had his academy, or country-house, for the entertainment of his philosophical friends, to whose conferences the world is indebted for his academical questions, and for his books on the nature of the gods. The academies in subsequent ages, however, extended the subjects of their inquiries; for instance, the members of the academy instituted by Charlemagne at Paris, under the direction of Alcuin, an English monk, and composed of the first wits of the court, were employed in making judicious and learned reflections upon some ancient and classical author in every branch of literature. The term academy has since been appropriated to places set apart for the promotion of literature and science.

Philo-Chemicus inquires how to find the direction of a magnet? The simplest plan is as follows:—Having found the poles of a magnet, if you place it on a small piece of cork, and make the cork to float on water, it will always place itself in one direction. The case will be the same with a magnetic needle made to float on water by the same means, or suspended on a fine pivot, so as to be at full liberty to move: it will always assume the same direction. To make a needle place itself north and south, it is not even necessary that it should be magnetised. If a very slender common needle be made to float on the surface of water in a state of perfect rest, at the end of some hours it will be found in the same direction as that suddenly assumed by the magnetic needle. The direction, according to which a needle, whether magnetised or not, arranges itself, is called the *magnetic meridian*, and must be carefully distinguished from the terrestrial or true meridian; for, in general, they form an angle with each other.

Scholasticus.—**Myrmillones** were Roman Gladiators who fought completely armed against the Retiarii. Their arms were a sword, head-piece, and shield. On the top of the head-piece they wore a fish embossed, called *μορμυρος*, whence their name is by some supposed to be derived.

NATURAL PHILOSOPHY.

Second Division.

CHAPTER XLVI.—(*Continued.*)

OF OPTICAL INSTRUMENTS.

The Magic Lantern consists of a metallic lantern, A A′ Fig. 286, in front of which two lenses are placed. One of these, *m*, is the illuminating lens, the other, *n*, the magnifier A powerful Argand lamp is placed at L, and behind it a concave mirror, *p q*. In the space between the two lenses the tube is widened, *c d*, or such an arrangement made that slips of glass, on which various figures are painted, can be introduced. The action of the instrument is very simple. The mirror and the lens *m* illuminate the drawing as highly as possible; for the lamp being placed in their foci, they throw a brilliant light upon it, and the magnifying lens, *n*, which can slide in its tube a little backward and forward, is placed in such a position as to throw a highly magnified image of the drawing upon a screen, several feet off, the precise focal distance being adjusted by sliding the lens. As it is an inverted image which forms, it is, of course, necessary to put the drawing in the slide, *c d*, upside down, so as to have their images in the natural position. Various amusing slides are prepared by the instrument-makers, some representing bodies or parts in motion. The figures require to be painted in colours that are quite transparent.

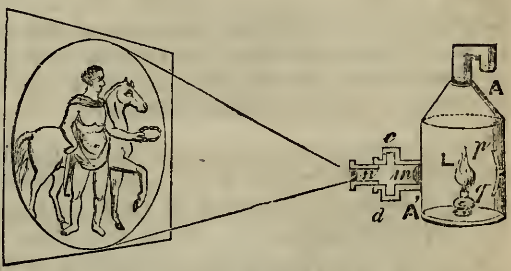

Fig. 286.

[By employing two distinct magic lanterns, or two lanterns inclosed in the same case, the dissolving views are exhibited.*—W. T. K.]

The Solar Microscope.—This instrument, like the magic lantern, consists of two parts—one for illuminating the object highly, and the other for magnifying it. It consists of a brass plate, which can be fastened to an aperture in the shutter of a dark room, into which a beam of the sun may be directed by means of a plane mirror. In Fig. 287, M is the mirror, to which movement in any direction may be given by the two buttons, X and Y, that rays from the sun may be reflected horizontally into the room. They pass through a large convex lens, R, and are converged by it; they again impinge on a second lens, U S, which concentrates them to a focus, the precise point of which may be adjusted by sliding the lens to the proper position by the button B. P P′

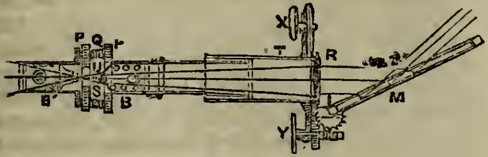

Fig. 287.

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* For ample explanations of the method of exhibiting the dissolving views, see the illustrated papers in the Family Friend, Pages 18—22, and 78—82, Vol. III., New Series.

is an apparatus, consisting of two fixed plates, with a moveable one, Q, between them, Q being pressed against P′ by means of spiral springs. This apparatus is for the purpose of supporting the various objects which are held by the pressure of Q against P′. Immediately beyond this, at L, is the magnifying lens, or object-glass, which can be brought to the proper position from the highly illuminated object by means of the button B′; and the magnified image resulting is then thrown on a screen at a distance.

The solar microscope has the great advantage of exhibiting objects to a number of persons at the same time.

In principle, the oxyhydrogen microscope is the same as the foregoing, only, instead of employing the light of the sun, the rays of a fragment of lime ignited in the flame of an oxyhydrogen blow-pipe are used. These rays are converged on the object, and serve to illuminate it. The advantage the instrument has over the solar microscope is, that it can be used at night and on cloudy days.

CHAPTER XLVII.

OF TELESCOPES.

Refracting and Reflecting Telescopes—Galileo's Telescope—The Astronomical Telescope—The Terrestrial—Of Reflecting Telescopes—Herschel's, Newton's, the Cassegrairian, Gregory's, Lord Rosse's, Mr. Lassell's, and the Craig Telescope—Determination of their Magnifying Powers—The Achromatic Telescope.

THE telescope is an instrument which, in principle, resembles the microscope, both being to exhibit objects to us under a larger visual angle. The microscope does this for objects near at hand, the telescope for those that are at a distance.

Telescopes are of two kinds, refracting and reflecting. Each consists essentially of two parts, the object-glass or objective, and the eye-piece. In the former, the objective is a lens, in the latter it is a concave mirror.

The distinctness of objects through telescopes is necessarily connected with the brilliancy of the images they give; and this, among other things, depends on the size of the objective.

There are three kinds of refracting telescopes:—1st, Galileo's; 2d, the astronomical; 3rd, the terrestrial.

GALILEO'S TELESCOPE, which is represented in Fig. 288, consists of a convex lens, L N, which is the objective, and a concave eye-glass, E E. Let O B be a distant object, the rays from which are received upon L N, and by it would be brought to a focus, and give the image, M I; but, before they reach this point, they are intercepted by the concave eye-glass, E E, which makes them diverge, as represented at H K, and give an erect image, *i m*. This form of telescope has an advantage in the erect position of its image, which is usually presented with great clearness. Its field of view, by reason of the divergence of the rays through the eye-glass, is limited. When made on a small scale, it constitutes the common opera-glass.

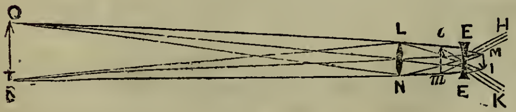

Fig. 288.

THE ASTRONOMICAL TELESCOPE differs from the former in having for its eye-piece a convex lens of short focus compared with that of the object-lens. In this, as in the former instance, the office of the objective is to give an image, and the eye-piece magnifies it precisely on the same principle that it would magnify any object. In Fig. 289,

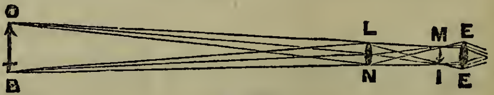

Fig. 289.

L N is the objective, and E E the eye-glass; the rays from a distant object, O B, are converged so as to give a focal image, M I. This being viewed through the eye-lens, E E is magnified, and is also inverted. The magnifying power of the telescope is found by dividing the focal length of the objective by that of the eye-lens.

This telescope, of course, inverts, and therefore is not well adapted for terrestrial objects; but for celestial ones it answers very well.

THE TERRESTRIAL TELESCOPE consists of an object-lens, like the foregoing, but in its eye-piece are three lenses of equal focal lengths. The combination is represented in Fig. 290, in which L N is the object-lens, and E E, F F, G G the eye-lenses, placed at distances from each other equal to double their focal length. The progress of the rays through the object-lens and the first eye-glass to X is the same as in the astronomical telescope; but, after crossing at X, they are received on the second eye-lens, which gives an erect image of them at *i m*, which is viewed, therefore, in the erect position by the last eye-lens, G G.

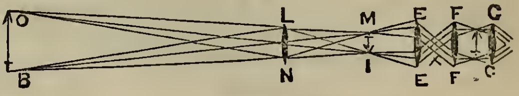

Fig. 290.

As the distance at which the image forms from the object-lens is dependent on the actual distance of the object itself, one which is near giving its image farther off than one which is distant, it is necessary to have the means of adjusting the eye-piece, so as to bring it to the proper distance from the image, M I. The object-lens is therefore put in a tube longer than its own focus, and in this a smaller tube, bearing the three eye-lenses, immoveably fixed, slides backward and forward; this tube is drawn out, until distinct vision of the object is attained.

REFLECTING TELESCOPES are of several different kinds. They have received names rom their inventors.

HERSCHEL'S TELESCOPE consists of a metallic concave mirror, set in a tube in a position inclined to the axis. It of course gives an inverted image of the object at its focus, and the inclination is so managed as to have the image form at the side of the tube. There it is viewed by an eye-lens, which shows it magnified and inverted. The back of the observer is turned to the object, and the inclination of the mirror is for the purpose of avoiding obstruction of the light by the head.

NEWTON'S TELESCOPE consists of a concave mirror, A R, Fig. 291, with its axis parallel to that of the tube, D E F G, in which it is set. The rays reflected from it are intercepted by a plane mirror, C K, placed at an angle of 45°, on a sliding support, m. They are, therefore, reflected towards the side of the tube, the image, *i m*, forming at I M, an eye-glass at L magnifies it.

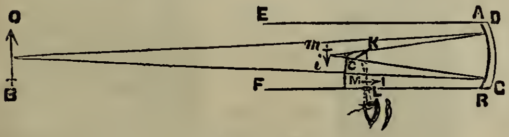

Fig. 291.

[THE CASSEGRAIRIAN TELESCOPE.—The great speculum of this instrument is perforated like the Gregorian; but the rays converging from the surface of the mirror, A B, Fig. 292, towards the focus *a*, are intercepted before they reach that point by a small convex mirror, *d*, not sufficiently convex to make the rays divergent, but of such a curvature as to prevent them from coming to a focus till they are thrown back to *b*, near the aperture in A B, where they form an inverted image, which is viewed by the eye-piece E. This construction has the advantage of requiring a shorter tube than the Gregorian; but the inversion of the image is not corrected; and for this reason probably it has not been much used.

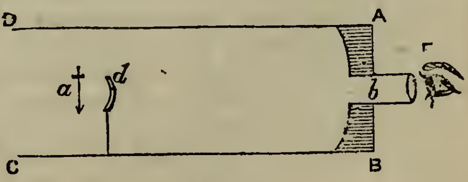

Fig. 292.

The small mirror, *d*, is adjusted by means of a rod turning on a shoulder near the eye-end of the tube (the same as in the Gregorian telescope), and connected by a screw with the apparatus which carries the wire to which the mirror is attached.—*Brande's Dict of Science, Literature and Art, p.* 1220.]

The Gregorian Telescope has a concave mirror, A R, Fig. 293, with an aperture, L, in its centre. The rays from a distant object, O B, give, as before, an inverted image, M I. They are then received on a small concave mirror, K C, placed fronting the great one. This gives an erect image, which is magnified by the eye-lens, P.

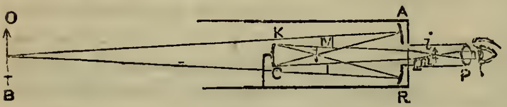

Fig. 293.

The magnifying power of any of these instruments may be roughly estimated by looking at an object through them with one eye, and directly at it with the other, and comparing the relative magnitude of the two images. In Herschel's telescope the back of the observer is toward the object, in Newton's his side, but in Gregory's he looks directly at it. The latter is, therefore, by far the most agreeable instrument to use. The largest telescopes hitherto constructed are upon the plan of Herschel and Newton.

[**Lord Rosse's Telescope**, which is nearly 50 feet long, with its huge wooden tube; **Mr. Lassell's**, with its sheet iron tube, and the **Craig Telescope**, are all wonders of modern Science. Our readers have already become familiar with the last instrument, as we gave a description and illustration of it in our last volume.—W. T. K.]

When Sir Isaac Newton discovered the compound nature of light, by prismatic analysis, he came to the conclusion that the refracting telescope could never be a perfect instrument, because it appeared impossible to form an image by a convex lens, without its being coloured on the edges by the dispersion of light. He therefore turned his attention to the reflecting telescope, and invented the one which bears his name. He even manufactured one with his own hands. It is still preserved in the cabinet of the Royal Society of London.

But after it was discovered that refraction without dispersion can be effected, and that lenses can be made to form colourless images in their foci, the principle was at once applied to the telescope; and hence originated that most valuable astronomical instrument, the achromatic telescope.

In this the object-glass is of course compound, consisting, as represented in Fig. 294, of one crown and one flint-glass lens, or as represented in Fig. 295 of one flint and two crown-glass lenses. The principle of its action has been described in Chapter XL. The great expense of these instruments arises chiefly from the costliness of the flint-glass, for it has hitherto been found difficult to obtain it in masses of large size, perfectly free from veins or other imperfections. Nevertheless there are instruments which have been constructed in Germany, with an aperture of thirteen inches. Some of these are mounted on a frame, connected with a clock movement; so that when the telescope is turned to a star it is steadily kept in the centre of the field of view, notwithstanding the motion of the earth on her axis. Several large instruments of this description are now in the various observatories.

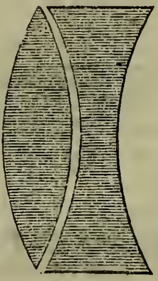

Fig 294.

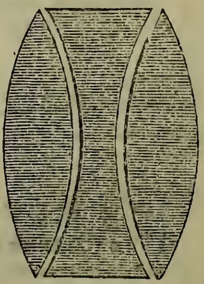

Fig. 295.

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PRACTICAL ESSAYS ON EDUCATION.

ON DIET.

The mode in which children are fed is a very important matter in respect to their constitutional powers, on which, as most of my readers are aware, depend the due development of their moral as well as their bodily faculties. In order that an individual may have a sound mind in a healthy body, he must be well fed, and "neither stinted nor stuffed."

Food should answer at least two important purposes—of supplying the material of nutrition requisite to balance the continual "wear and tear" taking place in the body, and of conveying into the system those elements which, by their chemical combination, elicit heat.

To ensure these important results, food must be, as I have already stated, wholesome and sufficient; it must also combine all that variety of animal and vegetable which Providence has so bountifully bestowed upon man. "When animals are in their natural state," says Dr. Bostock, "we find that most of them uniformly adhere to the same kind of food, and this in a very remarkable degree. . . . This is not, however, the case with man; for, within certain limits, his digestive organs are kept in a more healthy state by a due admixture of different kinds of food, than by any one article taken singly."

Dr. Prout has grouped, with his usual judgment, all nutritive substances into four classes, which he terms aqueous, saccharine, albuminous, and oleaginous. The first of these needs no elucidation; it is an abundant and necessary constituent of the body, and a universal component of our food. The saccharine class is derived from the vegetable kingdom; the albuminous chiefly from the animal realm; and the oleaginous from both. "A diet," writes the learned doctor, "to be complete, must contain more or less of all the four staminal principles; such, at least, must be the diet of the higher classes of animals, and especially of man."

A very pernicious habit, in which children are frequently indulged at home, is that of almost incessant eating. Many mothers encourage it from the facility with which, for a time, the offer of "something nice" procures peace and quietness. But the child, even from infancy, ought to be gradually accustomed to eat only when hungry, and when food is really required. After two years of age, an interval of four hours between meals will rarely be more than enough; to give biscuit, fruit, bread, &c., in the meantime, is just subtracting from the digestive power of the stomach. Like other organs, the stomach requires a period of repose after the labour of digestion.

It is a great mistake that some parents labour under, in supposing that children would not be quiet or contented without such indulgence. On the contrary, I can assure them that they would be, most certainly, healthier and happier, were the opposite system steadily pursued. The child's bodily and mental faculties must, however, be duly attended to; and then he will not think of eating till the return of appetite enforces the demand.

Too little consideration is, in general, paid to the adaptation of the food, both in quantity and quality, to the age of the individual, as well as to the powers of the digestive organs; and the evil consequences of this neglect are often evident in those children who are allowed an unrestricted use of the most exciting kinds of animal food.

"In early life," says Dr. Combe, "when digestion is vigorous, the system excitable, and the habits peculiarly active, a full proportion of vegetable and farinaceous food is proper and salutary. Morning and evening meals of this description, prepared with milk, or taken along with it, are very useful—animal food being reserved for dinner alone."

Pastry, rich cakes, puddings, and other articles containing much fatty or oily matter, are perhaps the most generally indigestible of all kinds of food, and consequently should seldom, if ever, be given to children. It is pleasant, I know, for grandmothers and aunts to bestow these nice things upon those they love, and they may deem it kind and generous to do so. But it is, in fact, mere selfishness. These things are very deleterious to children; and those who give them should be taught that they are purchasing the momentary smile of satisfaction at the risk of after sickness.

If animal food be given too early, or in too great quantity, the system becomes excited, and diseases of irritation are almost sure to be produced, which impede nutrition, and lead ultimately to the production of scrofula and other organic changes in the glands and bowels, and frequently also in the brain and lungs. In these instances the child generally eats heartily, but nevertheless continues thin, and is subject to frequent flushing and irregularity of the bowels, head-aches, and restlessness. His mind partakes of the general irritability of the system, and feverish impatience takes the place of the placid good-humour natural to healthy childhood. In this state the ordinary diseases of infancy—measles, scarlet-fever, and hooping-cough—are often attended with a dangerous degree of constitutional disturbance; and when inflammation takes place the necessary depletion is borne with difficulty, and the system does not easily rally.

Let it be remembered, then, that by using highly stimulating food improperly, many children incur much suffering from imperfect nutrition, and the diseases to which it predisposes. Sir James Clark, after making some very judicious remarks on the influences of bad digestion in inducing the consumptive constitution of the body, expresses himself strongly on the evils of which I have just spoken.

"Food in excess," he says, "or of a kind too exciting for the digestive organs, may also induce tubercular cachexia—a circumstance which is not sufficiently attended to—I may say, not generally understood, even by medical men; nevertheless I hold it to be a frequent cause of scrofula, and believe that it produces the same effect on the system as a deficient supply."

Although the premature use of animal food is thus injurious, a certain proportion of it becomes essential to health after the body has become sufficiently developed: because the instruments of mastication are now fully adequate for their office, and the stomach is no longer oppressed by the effort of digesting it.

Dr. Combe, in his celebrated treatise—"The Physiology of Digestion"—thus enforces this line of conduct:—

"From the age of six or seven years, up to that of puberty, when the animal activity is at its height, growth in full progress, and the nutritive functions in their greatest vigour, a larger proportion of animal food, and a more generous diet, become necessary to the enjoyment of health and vigour; but they must still be accompanied by ample exercise and free exposure, otherwise they will tend only to clog and impede the functions of life."

The error of not providing a sufficiently nourishing diet for the young is, often from kind but mistaken views, much more prevalent than it ought to be. Some children, especially girls, are really only half fed, for fear of making them lose their slim figures, and becoming gross, as it is termed. Dr. Hope "believed that exposure to cold, and inadequate nutrition in childhood, sowed the seeds of the disease which was developed in later years."

Those children who display no unusual irritation of the nervous system, not only bear but require a larger proportion of animal food than their more delicate and sensitive companions. Not only is their digestion more vigorous, but the waste going on in the system is much greater, and the nutritive functions are more active; the need, therefore, for nourishing food.

We read of Warren Hastings, that "he always attributed his smallness of stature to the hard and scanty fare" of a school at Newington, where he was "well taught, but ill-fed."

In choosing schools, I would recommend parents to be careful in making inquiries respecting the ordinary diet. A child's diet should be light and nourishing. "Bread and milk are best for his morning and evening meal," says Mr. South. "He should not have meat alternate days, and be compelled to check his hunger on the other days of the week with dough dumplings—known familiarly among schoolboys as 'dampers.' He ought to have plain butcher's meat, once daily, in proportion to his age and the quickness of his growth and his activity; and in consequence of the two latter circumstances, one child will, of necessity, require more food than another; and therefore it is absurd to determine one particular quantity for all children of the same age."

Every physician urges that children should dine at an early hour. "On no account," says Dr. Andrew Combe, "ought dinner to be delayed beyond one or two o'clock."

In some schools the duties are so irrationally arranged, that while the children are obliged to breakfast early, even in winter, most of them find it impossible to dine till five or six o'clock—eight or nine hours after the first meal, instead of four or five !

If it were a favourite colt or dog whose training we were superintending, the folly of shutting it up all day in a confined atmosphere, and denying it exercise and food at proper intervals, would be at once perceived.

The arrangement, however, is the source of much suffering and disappointments; and, as it cannot be corrected until the public is rendered fully aware of its existence and influence, it cannot be too often brought under notice, or too strongly condemned.

The teacher alone has not usually the power of providing a remedy. The concurrence and co-operation of the parent are in general indispensable; but both combined could easily effect such a distribution of the time and business of the school, as to leave a couple of hours in the middle of the day appropriated to dinner, and play after it in the open air.

I have no hesitation—supported as I am by the most experienced medical men—in condemning variety in a single meal, however much variation of diet may be generally useful; for variety of dishes is simply an ingenious device for heaping an unnatural load on the stomach.

Byron, after partaking of

"Fish, and soup, by some side dishes back'd,"

thus writes in his Diary, under 1821:—"Last night suffered horribly from an indigestion. I remarked in my illness the complete inertion, inaction, and destruction of my chief mental faculties. I tried to rouse them, and yet could not."

There are some individual peculiarities of constitution occasionally met with, in which the most wholesome food proves noxious; as in the example furnished by Dr. Prout, of a person who was unable to eat mutton without being seriously ill. The peculiarity was thought to arise from caprice; and the meat was repeatedly disguised, but invariably it produced the same injurious effects. Mr. Erasmus Wilson mentions another case. A farm-servant could not be induced to partake of a Michaelmas dinner, because a turkey stuffed with sage and onions was to be one of the dishes. Dr. Dunglison states also that a friend of Tissot could not take sugar without its exciting vomiting. I knew a youth who was compelled to leave the dinner-table, whenever turnips were placed upon it.

When children are met with possessing similar peculiarities of constitution, it behoves their parents or teachers to treat them with becoming kindness and consideration.

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LESSONS IN NATIONAL HISTORY.

No. VII.

CHINA AND ITS REVOLUTIONS.

As we have already stated in our last number, the late Emperor of China, TAU-KWANG ("the glory of reason"), ascended the throne in 1820. He was the second son of Kea-king, and the grandson of the illustrious Kien-long. He was chosen by Kea-king as his successor, in consequence of his having saved his father's life in the insurrection of 1813. His reign is important, in an historical point of view, as he is the first Chinese sovereign whose name is intimately connected with English history; and his reign is, therefore, deserving of a more lengthened notice than we have hitherto bestowed on any of the preceding ones.

No sooner was Tau-Kwang seated on the throne than a serious insurrection broke out in the western districts of Little Bucharia, which had been annexed to the empire by Kien-long. Cashgar was one of the chief scenes of the revolt, which, after a struggle of several years, was suppressed by the imperial troops. But scarcely was peace restored, when the repose of the country was again disturbed by another rebellion of the mountaineers, known by the name of the Miao-tzes, who had become a numerous and formidable people, notwithstanding the destruction of some of their tribes by Kien-long. To this race of mountain warriors there is at this time more than ordinary interest attached, in consequence of their being the chief belligerents of the present insurrection in China, and their country being the focus where this formidable rebellion was hatched. The same spirit of bravery and independence which they now exhibit, appears to have manifested itself in the time of Taoukwang. These Miao-tzes suddenly poured down in great numbers from their native hills in the south-western province of Quangsi, under the command of a chieftain, who assumed the name of Wong, or king, and not only displayed the imperial ensign of the Golden Dragon, but wore a yellow robe, which is the direct assumption of the Chinese imperial dignity. All the mountain tribes—which are about seven in number, each governed by a separate chief—enlisted under the banners of this daring leader, and descended to the plains, where they defeated the imperial troops, and possessed themselves of four towns, from which they expelled the soldiers and mandarins, but did not injure the rest of the inhabitants; declaring, by a public proclamation, that they were not the enemies of the people, but of the government.

The viceroy of Canton, Governor Le, received orders from Pekin to put an end to the rebellion; and, with that view, he assembled what he supposed would be a sufficient force to defeat them; but they were more formidable than he expected, and his army was repulsed with great loss; in consequence of which misfortune he was degraded and deprived of his government; for the spirit of Chinese law is, that if a general is commanded to conquer, he must obey.

Another mandarin—the viceroy of Honan—met with better success; and having retaken one of the towns occupied by the mountain bands, was rewarded with a peacock's feather, which is the highest badge of military distinction among the Tartars. Still the rebellion was not terminated; and the Miao-tzes held out with determined obstinacy for nearly six years, when, in 1838, two Imperial commissioners were sent from Pekin to treat with them upon amicable terms, and (by what means is not exactly known, although it is suspected large presents were not spared) induced them to return quietly to their homes. It was then publicly announced that the rebels had been obliged to make the most humble submissions; but as they are as independent now as they were before, it is quite evident that they were rather appeased than subdued.

Scarcely had the mountain tribes laid down their arms, and retired once more in peace to their native wilds, than a war broke out of a totally different nature from any that had yet disturbed the Celestial Empire. Hitherto, the people of China had only been called upon to contend with barbarous nations, whose mode of warfare was familiar to them; and, moreover, they had been accustomed to look upon the English with a degree of contempt, owing to the fact of never having known them in any other character than that of traders. Unconscious of their own inferiority in knowledge of the art of war, or of the improvements in weapons, and wholly ignorant of the great advantages which discipline always gives over numbers, they treated our countrymen as foes rather to be despised than dreaded, and entered, without apprehension, into a contest, the result of which was certainly to them most unexpected.

The insults and extortions of the Chinese authorities at length became so intolerable, that a rupture was inevitable. In 1840, the Government of China, having entered into a serious and protracted dispute with Great Britain, on the subject of importing opium, which the Chinese, by decree, excluded from their ports, and the Chinese authorities having subjected the British merchants to repeated injuries and insult, a powerful fleet was sent out under the direction of Sir Henry Pottinger, as high commissioner. On the arrival of the fleet, Sir Henry took possession of Hong Kong, effected the reduction of Canton, blockaded the river, and exacted a heavy ransom from the inhabitants. The expedition then proceeded northward, with the intention of attacking the fortified city and island of Amoy, situated in a fine gulf in the province of Fokien, the great tea district of China, and about 350 miles north-east of Canton. The defences were mounted with no less than 500 pieces of cannon.

In the month of August, 1841, the British expeditionary force arrived before Amoy. It consisted of 34 vessels, including several new steamers. Admiral Parker had command of the fleet, and Sir

Hugh Gough of the land forces. The city was bombarded for two hours, after which Sir Hugh Gough landed, and seized one end of the long battery; while the 26th Regiment, with the sailors and marines, carried the strong batteries on the island of Koolangsee, just in front of Amoy. The Chinese made an animated defence for four hours, and then fled from all their fortifications and the city. The Chinese gunboats and war-junks were all captured. The cannon, with immense munitions of war, fell into the hands of the captors. Sir H. Gough then entered the city, at the head of his troops, without opposition. The fortifications were dismantled, and the cannon destroyed.

After leaving a garrison at the island of Koolangsee, the expedition again sailed northward. On the 1st of October an attack was made upon Chusan. The British troops, supported by the fire of the ships, ascended a hill, and escaladed Tinghae, the capital city, from which the British colours were soon seen flying in every direction. On the 7th the troops attacked the city of Canhae, on the mainland, opposite Chusan, and captured it.

On the 15th of October, a portion of the expedition, consisting of 750 men, with sappers and artillery, proceeded to Ningpo, about fifteen miles up the river. Here no opposition manifested itself. The troops escaladed the walls, and the Chinese populace assisted in removing the obstructions, and opening the gates, saying, that as the mandarins had deserted them, and the soldiers were unable to protect them, they threw themselves under British protection. The British soon after captured another town, called Hong-kong-foo.

After an abortive attempt to destroy the garrison at Ningpo, the Chinese encamped, about 6,000 strong, about eleven miles westward, with a view of cutting off the supplies. A force of about 1,100 men were therefore embarked, and towed up the river by the steamers till opposite the enemy. An attack having been made, the Chinese were dispersed in all directions, leaving near 700 dead on the field.

At Tsekee, about twenty miles from Ningpo, Sir H. Gough attacked and routed, with 1,000 bayonets, a Chinese army of 10,000 men, the greatest portion of which consisted of picked troops, and a part of the Imperial Body Guard, with a loss to them of 1,000 killed, and large quantities of military stores.

On the 18th of May the large town of Chapoo, forty miles from Chusan, was captured. Only forty Tartars survived the conflict.

At this period new re-inforcements from England and the East Indies had arrived; so that we had 56 ships-of-war in the Chinese waters, 50 transports and store ships, and 15,000 fighting men, besides marines. With this re-inforcement the British expedition, on the 13th of June, entered the large river, called *Yang-Tze-Kiang,* on the banks of which were immense fortifications. The British troops then took possession of the important city of Shanghae, whose commerce and population have been reckoned as equal to London.

On the 20th the vessels anchored abreast of the strongly-fortified city of Ching-Keang-foo, which commands the entrance of the Grand Canal. The city was manfully defended by the Tartar soldiers. At length the British became complete masters of the place. About forty mandarins were killed and wounded. The Tartar general, when he saw that all was lost, retired to his house, and caused his servants to set it on fire, while he was burnt to death as he sat in his chair.

Leaving a strong garrison for the retention of Ching-Keang-foo, the fleet proceeded towards Nankin, about forty miles distant, and arrived there on the 6th of August. Active operations were about to be commenced, when a letter was received by the British plenipotentiary, requesting a truce, and stating that certain high commissioners, specially delegated by the Emperor, and possessed of full powers to negotiate, were on their way to treat with us. The attack was consequently deferred; but the commissioners did not arrive till the 15th. After several visits, and a good deal of discussion between the contracting parties, the conditions were ultimately arranged to their mutual satisfaction.

On the 29th of August a treaty was publicly signed on board H. M. S. Cornwallis, by Sir H. Pottinger and the three commissioners. Of this convention the following are the most important articles by which England and China continued to be guided: 1. Lasting peace and friendship between

HIEN-FUNG, THE EMPEROR OF CHINA.

the two empires. 2. China to pay 21,000,000 dollars in the course of the present and the three succeeding years. 3. The ports of *Canton, Amoy, Foo-Choo-foo, Ningpo,* and *Shanghae,* to be thrown open to British merchants, consular officers to be appointed to reside at them, and regular and just tariffs of import and export duties to be established. 4. The island of Hong Kong to be ceded in perpetuity to her Britannic Majesty, her heirs, and successors. 5. Correspondence to be conducted on perfect equality among the officers of both Governments. 6. On the Emperor's assent being received to the treaty, and the payment of the first instalment of 6,000,000 dollars, her Britannic Majesty's forces to retire from Nankin, and the Grand Canal and the military posts of Chinhae to be also withdrawn; but the islands of Chusan and Kolangsee to be held until the money payments and the arrangements for opening the ports should be completed.

In a supplementary treaty there was a clause to guarantee to all foreign nations the same privileges of trade as to the British.

Since the termination of this important contest, so favourable to the English, and so honourable to the British arms, the Chinese authorities have been kept in due subjection; and, with the exception of a few isolated disputes, nothing has occurred to disturb our amicable relations with the Chinese empire.

On the death of Taou-Kwang, which occurred in 1851, his son, HIEN-FUNG, whose portrait is here annexed, succeeded to the empire of China, and is now the reigning sovereign; but from the present aspect of affairs in the Celestial empire, and the possibility of his being the last of the Mantchou dynasty, an extraordinary degree of interest has sprung up in connexion with China and the future fate of its youthful monarch.

Hien-Fung is only twenty-two years of age. He is of middle height, and his form indicates great aptitude for bodily exercises. His face, which indicates a certain degree of resolution, is chiefly characterised by a very high forehead, and by an obliquity of the eyes. His cheek-bones are strongly marked, and very prominent. The space between the eyes is large and flat, like the forehead of a buffalo. He is already married to a Tartar princess.

The Emperor Hien-Fung has not been sufficiently long in power to enable us fully to judge of his political or moral character; but from all we can hear, he manifests the same ridiculous assumption of power as his predecessors, and the same rigid observance of ancient customs. From a contemporary writer, who has long resided in China, we have been able to glean the following particulars:—

It is customary for the Chinese emperors to repair, at certain times, to the important city of Moukden, in Mantchuria, in order to venerate the relics of their ancestors, when sacrifices are offered to render their manes propitious. The late emperor, however, not being able to visit or reside at Moukden, on account of the place not being sufficiently central to direct and govern his empire, sends thither every ten years his *portrait*, or, according to the Chinese expression, "his holy face" (*Cheng-yng*). This portrait is conveyed by one of the princes of the blood, on a gorgeously ornamented car. It is adored, and sacrifices offered to it: for the emperor being reputed son of heaven, they render to him, even before his death, divine honours. But what surpasses all European ideas on this subject is, that at the conveyance of his portrait, just as when the emperor comes in person himself, the authorities construct expressly for it, from Pekin to the palace of Moukden (a distance of two hundred leagues), a road from fifteen to eighteen feet wide, formed generally in the middle of the public way. It is usually one foot higher than the rest of the thoroughfare. No one is allowed to go by this route; travellers proceed along the sides. Although this elevated road is often only of earth, many millions are expended on the vain ceremony; but the money which is advanced by the emperor is pocketed by the mandarins, and the amount levied upon the inhabitants. From this ridiculous custom, some notion may be formed of the Chinese government.

According to the general custom of all the eastern monarchs, the wives of the Chinese emperor are very numerous; and none of the Tartar nobles or princes can dispose of his daughter in marriage, unless the emperor, to whom she is presented, declares that she is not required in his imperial harem.

Notwithstanding all the honours and regal power conferred upon the Emperor of China, he is in reality an absolute recluse in his Palace of Lay-tien, which is situated about four leagues from Pekin. He thus understands little of state affairs. The absurd ceremony which surrounds him, renders him inaccessible to truth. Every communication made to him reaches him manufactured by his *tat-cheng*, or *tsay-siang*, the mandarins of his palace; and, besides, he is so infatuated with his pretended grandeur, so terrible, so ridiculous, so implacable in his vengeance, that the great art of the court is to deceive him, and persuade him he has been always successful. The inspectors sent into the provinces are infallibly corrupted, and the report which they give will be moulded *according to custom.* Thus his armies, which he supposes to be innumerable and invincible, have little existence except on paper; and the mandarins, who understand their trade, keep for themselves, as an addition to their salaries, the enormous sums destined for the pay of these muster-rolls of soldiers.

All these flagrant abuses in the Chinese government cannot fail, eventually, to lead to its overthrow, and will readily account for the success of the insurgents in the present formidable rebellion, which will form the subject of our next paper.

◆

ELEMENTS OF COMPOSITION, AND CULTIVATION OF STYLE.

It is extraordinary that so much inattention to the first elements of Composition, or to the cultivation of Style, should be so generally neglected both in our private and public schools, although it is fully admitted that a correct facility of writing is the most useful and necessary branch of education required in the various affairs of practical life. In our inferior schools, Composition is seldom thought of,—the first elements of reading, writing, arithmetic, being considered sufficient for the ordinary routine of a common education. At the higher grammar schools, the pupils are chiefly instructed in the Latin and Greek languages, or the higher branches of mathematics; and the only opportunity they have of practising the art of writing, is in the translations of those languages. The usual consequence is, that they leave school at fifteen or sixteen years of age, utterly incapable of freely, or even correctly, expressing themselves in their mother tongue, although years may have been devoted to the study of the classical languages.

We know that, prior to 1846, though many of the schools were distinguished for mental activity, still the knowledge of the pupils, generally speaking, was crude, inexact, rambling, and incomplete. The subject of Composition was then almost neglected. Even dictation exercises were very seldom practised, and no substitutes used to test the progress of the individual pupils for the purpose of discovering in which particulars greater accuracy was required. In the late educational movement, however, the importance of Composition was recognised by the Government. In fact, it formed the subject of special recommendation by the Committee of Council to Schoolmasters; and it is not the least of the improvements that elementary education has gained from the superintendence of the Government. By a course of "Composition Exercises," judiciously arranged, the pupils will acquire accuracy along with facility of expression; and the training of those mental powers which will enable them to write their language with propriety.

It is quite certain, that if Composition be useful, as well as ornamental, for the general purposes of life, it should be as extensively practised as possible. There is nothing but inability to write that should prevent every boy, who is old enough to think, from reproducing his thoughts on paper. Composition should therefore be practised by the whole school instead of being confined to a section of the elder boys. One of the chief excellences of the King's Somborne School (according to the Report) was the general practice of composition, of which the Rev. H. Moseley thus speaks:—"All the children in the school, except five, write on slates, and all, except those of the lower class, are accustomed to write, not only from copies and from dictation, but, in some degree, from their own thoughts."

The chief requisite in making the practice thus general, is to adapt the subject to the most prominent differences of capacity and acquirements that characterise the pupils of every public school.

◆

NATIONAL SCHOOLMASTERS.

Of late years (says the Educational Expositor) it is well known that great sums of money have been expended on institutions for the education of teachers, for affording them assistance in their labours, for improving their own position and means, and for encouraging the advancement of learning in many other ways. This movement has arisen from a growing conviction that the future prosperity of the country depends, under Providence, on the principles with which the rising generation are imbued. Anxious to insure, as far as possible, the instilling of principles of religion and useful knowledge, the promoters of education have first prepared men and women, by the best means in their power, for the important office of teachers of the children of the poor—an office at once so dignified in itself, so responsible, and requiring such a union of intellectual and moral powers for its successful discharge, that it is second to no other profession.

That tuition is a profession in the highest sense of the word there can be no doubt, if we admit that the education which it is intended to impart consists, not in the mere acquisition of the mechanical power of imitating letters, of articulating written symbols of ideas, or of combining figures to obtain results, which, it is well known, can be obtained from mere machines; but that this education, using these arts as means to an end, has for its object the development of man's intellectual and moral powers, and the direction of them to the great purposes for which they were bestowed—his temporal and eternal welfare. Compare for a moment the great purpose of this office with that of any one of the professions usually so called. We esteem highly those who practise the art of healing, and they justly deserve it. The study of that "little world''—a man—even as regards only the framework of his being, is indeed a dignified study; but surely the development and direction of the various faculties and affections of the human soul is not a pursuit in any degree inferior, either in its nature or in its objects, to the art of the physician. The business of the Schoolmaster has something in common with every profession, however dignified, which aims at the improvement and happiness of the human race.

The office, it is true, has been too long filled by unworthy men, and this, no doubt, has brought it into disrepute; but the dignity of the office itself is not impaired by the unworthiness of the individual that may happen to fill it. In days gone by, the physician's art was only practised by the gentle ladies of the land, and the few surgical operations that were performed were entrusted to the hands of the "leech" or the barber. It is not intellect alone that we require in the schoolmaster; he may know all the *ics* and *ologies*, and be after all unfitted for his duties. We deem of the *first* importance a deep conviction of the power and efficacy of religious principles, manifested in all his teaching, and in his whole personal life and conversation.

It is true that the formation of the child's moral character is the province of the parent; but unhappily, in the present state of the lower classes in this country, the parent is too frequently unable to give the child a proper moral and religious training. In such cases the teacher must endeavour to supply this deficiency as far as he is able; and in doing this he will be sometimes found to work in the face of principles, maxims, and habits, diametrically opposed to those which he feels it his duty to inculcate, and while denouncing evil in the general must often unavoidably bring the mind of the pupil to condemn the habits and maxims of some of his nearest and dearest friends. What schoolmaster cannot bear testimony to something of this kind? Some guileless child ere now, when hearing of the heinousness of particular vices, has declared, in all simplicity of heart, " My father or my brother was that or did that.''

In the present state of education among the poor the teacher must, to a certain extent, supply the place of parent in the formation of the moral character of the children. If the teacher does it not, it will not be done at all, or at least done indifferently; and what benefit do we then confer by our education? We only increase the evils resulting from the want of moral training by giving more head-knowledge—by letting in a little more light on eyes long accustomed to the gloom, we either blind them, or lead them to believe that they have the full brightness of the day of knowledge.

If this indeed be the vocation of the schoolmaster, "what manner of man ought he to be?" "Who can say he is sufficient for these things?" The teacher has in his hands a power which, notwithstanding the opposition that it may occasionally meet with in the circle of home, is calculated in all cases to produce beneficial results. The England of future ages will owe a debt of gratitude to this generation for the training of brave and loyal sons, if the teacher conscientiously discharges his sacred duties; and the results of the great educational experiment now being made depend mainly on the National Schoolmaster.

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PROFESSOR NEWMAN ON ANCIENT LITERATURE.

In Professor Newman's translation of the " Odes of Horace," recently published, there are some valuable passages in the preface prefixed. The writer has had the courage to declare what has long lain, we have very little doubt, as a conviction in the breasts of many other persons competent to form an opinion upon the same subject, namely, that modern European literature has eclipsed the ancient; not as a mere fact that it is more universally cultivated—of which, of course, there could be no second opinion—but that it is intrinsically more attractive and valuable :—

" More than three centuries ago, the Greek and Latin classics began to be studied with great zeal, for the sake of their literature, which was then the most valuable in the world, and the only medium for attaining the highest cultivation of the day. That stage of progress is past, never to return. Modern European literature has now eclipsed the ancient; and among those who still study Greek and Latin, as languages for grammatical objects, fewer and fewer can afford the time and effort of studying the literature. When commercial England attains a higher mental culture, it will not be that of Oxford and Cambridge, but that of Germany and America combined. Already Greek is as impossible an attainment as Sanscrit to numbers of educated men: Latin is acquired, perhaps, at school, but imperfectly mastered; so that even Latin literature is unstudied in later life. I do not say this as blaming or deploring the result; on the contrary, when it rises out of the pre-occupation of the mind with deeper truths, and purer beauty, than was given to the ancients to attain, I cannot but rejoice. At the same time I conceive that every educated man who feels it inexpedient to encounter the effort of learning two difficult dead languages, and exploring their literature, must desire to know whatever may be known in English concerning those master-minds of the ancients, who have so affected the European intellect; and this gives a great value to select translations. Undoubtedly, a great poet can never be fully translated from a more powerful into a less powerful language; it is as impossible as to execute on soft wood the copy of a marble statue. Yet some approximation may be attained, which gives to the reader not only a knowledge of the substance, but a feeling of the form of thought, and a right conception of the ancient tone of mind. Hitherto our poetical translations have failed in general, not so much from want of talent or learning, but from aiming to produce poems in *modern style*, through an excessive fear that a modern reader will endure nothing else. I have been assured, that it is impossible to induce Englishmen to read poems in new metres. It may be so—but if so, I think it is equally impossible to induce them to read ancient poetry *at all*, in any metres, or in prose translations. Dickens and Thackeray are, I suppose, more amusing than Tennyson or Wordsworth, and leave to many men of business no time to read Milton or Thomson, or Virgil or Æschylus. I avow myself to despair of finding readers among those who seek solely for amusement. I bespeak for myself a thoughtful and serious reader, anxious for instruction. I assume in him no knowledge whatever of ancient languages or literature, except to have read Homer in a translation; and I endeavour to afford whatever is subsidiary to full intelligence—whatever will aid him to that close insight into men and times, which nothing but contemporary literature can ever give."

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ANOTHER PICTURE OF SOUTH STAFFORDSHIRE.*

"Sir,—As you have in a measure thrown open your pages of the Tutor to a certain class of men, perhaps you will not object to insert the enclosed, not for the sake of its literary ability, but for its facts.

"Thos. Mollard."

"Holyhead Road Academy,
Wednesbury, Stafford."

The rich and abundant stores of mineral wealth, contained in South Staffordshire, has raised thousands of its inhabitants to states of opulence and respectability. To that well-known bed of coal termed the ten-yard,† or thick coal, a strata running from east to west of South Staffordshire, many of the gentlemen who now possess their extensive iron-works, collieries, and factories, owe their wealth. The grandsires of our magistrates, our bankers, our lawyers, were colliers. We might easily enumerate families, rich and highly respectable, who in our school-boy days were among the poor and needy. Many of these gentlemen remembering "the hole of the pit whence they were dug"—to their great honour be it spoken,—are doing their utmost to amend the condition of those who are still in the humble ranks of common life.

There is no district in England where the labouring classes receive more money for their labour than in South Staffordshire; and there is not a place in England where the labouring classes and their children dress more respectably than in this district. Clean, sweet, healthy children, with colours "fairer than spring, and sweeter than the blooming rose," are incessantly the delight of the writer; and many a time in a day does he

"Upon their cheeks sweet kisses press."

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* See No. 66, page 151.

† This is often found 20 and 25 yards thick.

Not a few of these pictures of loveliness regarded with innocent smiles the strange attempt of a "modern tourist" (see page 151) to daub their snow-white pinnafores, blacken their rosy cheeks, and make their docile minds "as savages without the grace of savages." Strange exaggerations! The lowest of the low, the filthiest of the filthy, and the savagest of the savage, are not as superlatively so, as he has described them. In England are countries quite as black as South Staffordshire, but with the poor inhabitants so wretched and miserable as to render the poor men of South Staffordshire gentlemen to them in comparison.

The Black Country, too, is not without its natural and artificial beauties. On its eastern skirts stands that splendid pile of Anglo-Norman architecture, Dudley Castle, whose intricate walks and beautiful scenery gratify the taste of hundreds of thousands of visitors of all grades, who pay an annual tribute to its majestic ruins. On the east lies a beautiful tract of country for some twenty miles, enriched and bedecked with all the luxuriance which nature can afford. Here stands that sacred edifice, Lichfield Cathedral, so noted in our history for its antiquity, war, and bloodshed. All over this black country are studded, like stars in the sky, iron-works, coal-pits, churches, chapels, and schools—the sons of toil often as happy and as holy in the one as the other; and as often as the Sabbath rolls round, we see the tribes, with their little ones decently and often richly clad, repairing to the house of the Lord. And such also is the state of literature, that from the infant to the sage there is a thirst for truth,—religious and scientific truth within their reach, truth in their possession; and not unfrequently do we find among them the philosopher, the historian, the poet, and the linguist.

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DANCING IN AN EDUCATIONAL POINT OF VIEW.

In the days of our early ancestors, children were taught dancing as soon as they went to school, and the instruction was continued the year round; this, too, year after year, as a branch of general education, until a creditable proficiency was attained. This extension of time afforded the master an opportunity of not only "cultivating a marked talent for the accomplishment," but of doing that which must be deemed equally important, namely, training gradually those of his pupils who were less favourably circumstanced (and there are always some such), whether in point of intelligence or physical capability.

Dancing, under such favourable consideration, was *then* made "the means of disciplining the body into graceful habits, and of affording a healthful and pleasant exercise for the principal muscles." With such tendencies, dancing was in those days duly estimated as a prophylactic as well as a demonstrative and a corrective art; and therefore considered of paramount importance.

One of the items by which the reputation of the dancing master was upheld in former times, was *practice;* which was enjoined as one of the duties in common with the everyday routine of school business. The lesson was *then* varied according to the season of the year. In the warmer months it would consist of walking, curtseying, &c., together with the *minuet;* which is a "more legitimate dance than any of the quiet movements by which it has been superseded; and better calculated to render deportment unexceptionable than years of polking and quadrilling." In the colder season the lesson would be devoted to saltatory exercises, the gavotte, &c. The pupils were thus well grounded in the principles of dancing, "considered as an art;" and duly exercised in a way to produce activity and a true equilibrium. Moreover, as there were fewer sedentary occupations for young ladies then than now, to neutralize the effect of this physical training, it ought not to be matter of surprise that there was less awkwardness in those days, and better figures, than we meet with at present.

In ladies' schools this branch of education is frequently delayed, through the neglect of parents, until twelve, and from that to sixteen years of age; when six months'—or at most three quarters'—instruction is considered sufficient to give them a good carriage, and to prepare them for the usages of society; notwithstanding their every movement indicates the neglect of early training, and the necessity of continued instruction, assisted by *daily practice;* the latter, as an auxiliary, is however rarely turned to account, because it would occupy a certain portion of time which must be taken from fancy-work, or the *two hours' daily practice* of the piano.

At preparatory schools the time for the dancing lesson is rarely taken out of the half holiday. With but few exceptions it is the reverse in schools for boys who are considered to be past the age for preparatory instruction. This is a great disadvantage to the master, and a source of much annoyance to the boys; who, in many cases, prefer devoting the time to cricket or hockey than to dancing; and for this reason, if allowed to have their own way, will leave off, or refuse to learn at all; perhaps under the impression, that in after life they may be able to learn as much as they may require of "the most elegant amusement of genteel society," in four lessons for a guinea!

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PUBLIC SCHOOLS—No. IV.

QUEEN'S COLLEGE SCHOOL, BIRMINGHAM.

Birmingham for ages has been the great centre of British manufacturing industry; and amid all the phases of society, and the momentous revolutions of the body politic, she has steadily advanced in manufacturing prosperity and intellectual refinement. Amid all our commercial and political changes, Birmingham has not been negligent of those important objects which contribute to the architectural adornment of a locality, or the educational progress of the rising generation.

The public buildings of Birmingham present many noble specimens of architecture; although, until within a very few years (if we except her religious edifices), Birmingham had no public buildings of any pretensions to skill or beauty of design; but of late years, the commissioners and other superintending bodies have exhibited a laudable desire to beautify the town by employing the best architects. The Town-hall, for instance, is a magnificent building of the Corinthian order, the proportions of which are taken from the temple of Jupiter Stator at Rome. On the removal of the old Grammar School, in 1835, a magnificent building was erected in the Middle Gothic style, which now forms the High School of Birmingham, of which we gave a representation in page 104.

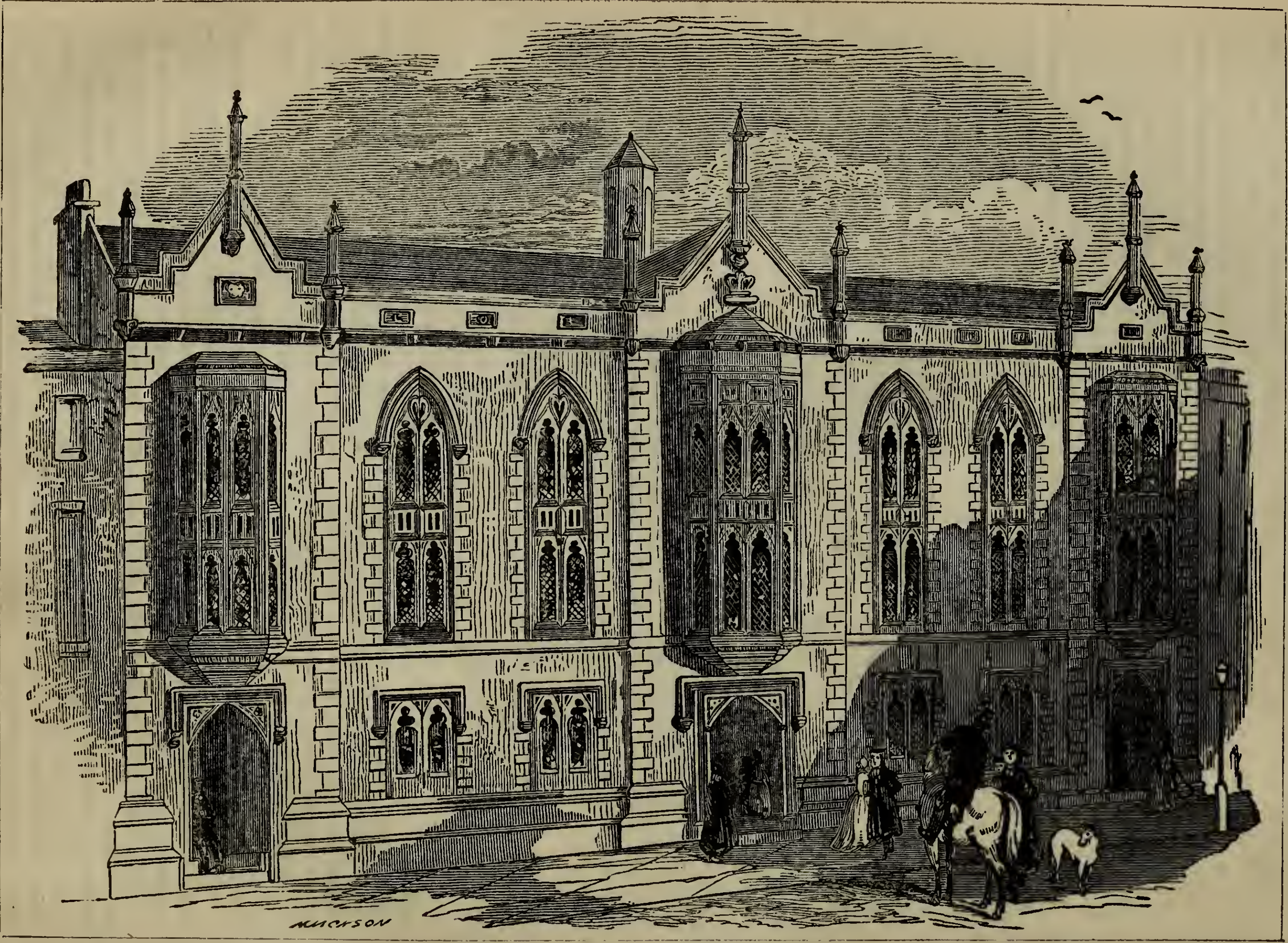
Birmingham also possesses a Chartered School, situated in Paradise Street, near the Town-hall. It was established in 1843, and is called "Queen's College." The annexed engraving is a faithful representation of its architectural features. The fine double bay windows at the centre and wings of the edifice—the large pointed frontage windows, with their splendid tracery and stained glass, and the elegance and symmetry of the whole façade, present to the eye of the spectator a pleasing and harmonious tout-ensemble.

The superb College Hall was designed by Messrs. Bateman and Drury, and contains portraits of Charles I., of Mary Queen of Scots, of Mr. Sands Cox, and other illustrious personages—all painted by the most distinguished masters. The elegant stained glass windows which adorn the edifice were executed by Messrs. Chance.

Connected with the College are museums of human and comparative anatomy, zoology, geology, and other departments of natural history. The library contains many thousand volumes of rare and choice books. Attached to the College is St. James's Chapel, which was consecrated in 1844, to which a beautiful stained glass window—"Christ Healing the Sick"—executed by Messrs. Pemberton, has been presented by the College students.

This institution is somewhat similar to the one at Durham. It was first established as a Medical School, by the exertions of Mr. W. Sands Cox, and has since been liberally endowed by the Rev. Dr. Warneford, to the extent of many thousand pounds, as hereafter enumerated. By this means the College has been placed in a position to maintain the various courses of study in the faculties of law, physic, divinity, and general literature, which may be required for taking a degree at the University of London, the Royal College of Surgeons, or the Society of Apothecaries.

The College is under the direction of a general Council; and the course of education pursued, under the authority of a royal warrant, qualifies for the degrees of B.M., M.D., B.A., M.A., B.C.L., and D.C.L., to be conferred by the University of London. The College buildings contain accommodation for upwards of 100 resident students. The medical department is under the charge of the Rev. G. Richards, M.A., the resident classical tutor, and a resident medical



QUEEN'S COLLEGE SCHOOL, BIRMINGHAM

tutor. The arts branch is under the care of the Rev. W. Hunt, M.A., resident senior mathematical tutor; and the general superintendence of the College is entrusted to a resident warden, the Rev. Prebendary Gray, M.A.

The School possesses the following endowments, which it has acquired as we have already mentioned, through the munificence of Dr. Warneford:—For the Warden, £1,500; for the Professors of Pastoral Theology, £4,400; for the Chaplaincy of the College, £1000; for the Divinity Lecturer, £1000; for the Medical Tutor, £1000; for the Chaplain of the Queen's Hospital, £1000; for the Warneford Prizes, £1000; and for the Warneford Scholars, £1000.

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INORGANIC CHEMISTRY.

CLASS IV.—METALS WHOSE OXIDES FORM POWERFUL BASES.

XXX. MANGANESE.

Equivalent, 27·67. *Symbol*, Mn. *Density*, 8.

Manganese is never found as a metal in nature, but may be produced from its black oxide by a high heat with charcoal. Metallic manganese is a gray brittle metal, not magnetic, and resembles some varieties of cast iron. It dissolves rapidly in sulphuric acid with escape of hydrogen.

Manganese in the form of the black oxide is an important and pretty common metal. Its great use is for producing chlorine, and in the manufacture of glass, where it acts by its oxygen to decolorize the compound.

The oxides of manganese are numerous; we give the formulæ of six, and there are possibly one or two more, viz., protoxide, MnO; sesquioxide (or braunite), Mn_2O_3; peroxide, or deutoxide (pyrosulite), MnO_2; red oxide (hausmannite), Mn_3O_4; manganic acid, MnO_3; hypermanganic acid, Mn_2O_7.

The *Protoxide* is a green-coloured powder, formed from heating the carbonate of manganese in hydrogen. It is a powerful base, attracts oxygen from the air, and is the base of the beautiful rose-coloured salts of manganese.

The sesquioxide or *braunite* occurs crystallized in octahedrons, and the forms belonging to the dimetric system.

The *Hydrated Sesquioxide* (manganite) is a finely crystallized mineral in long black prisms, found in superb specimens at Ilfeld, in the Hartz. In powder the sesquioxide is brown; it is decomposed by hydrochloric acid with the evolution of chlorine; but sulphuric acid combines with it to form a sesquisulphate, which yields a purple double salt with sulphate of potash (manganese alum), isomorphous with the corresponding salt of alumina. This salt is, however, very easily decomposed by a gentle heat.

The *Peroxide* is the most common ore of manganese, and has a high commercial value. It is found abundantly at Bennington, Vermont, and other places in America. When crystallized it is called *pyrolusite*, and beautiful specimens of this mineral have been observed at Salisbury and Kent, Connecticut, among the iron ores.

Manganic Acid is known only in combination, generally as manganate of potash. This is best formed by mixing equal parts of finely powered black oxide of manganese and chlorate of potash with rather more than one part of hydrate of potash dissolved in a very little water. This mixture, when evaporated, is heated to a point short of redness, and a dark green mass is formed, which contains manganate of potash. In this case the manganese obtains oxygen from the chlorate of potash, and the manganic acid thus formed combines with potash, giving a salt in green crystals. This salt, dissolved in water, gives a brilliant emerald-green solution, which almost immediately changes colour, being in quick succession green, blue, purple, and finally crimson-red, and has thence been called *chameleon mineral*. This last colour is due to the presence of *permanganic acid*, which, however, cannot be separated from its combinations, but forms a salt with potash in beautiful purple crystals. The compounds of permanganic acid are more stable than the manganates. The salts of these acids are respectively isomorphous with sulphates and perchlorates (SO_3 and Cl_2O_7).

The chlorides of manganese ($MnCl$ and Mn_2Cl_3) correspond to the protoxide, and sesquioxide. The *chloride* is formed abundantly in acting on black oxide of manganese, with hydrochloric acid. The mixed solution of chlorides of iron and manganese is evaporated to dryness, and then heated to dull redness. The chloride of manganese is then dissolved out from the dry mass, leaving the insoluble protoxide of iron behind. It has a beautiful pink tint, and deposits tabular rose-coloured crystals on evaporation. It is soluble in alcohol, and fusible by heat. The *sesquichloride* is formed by solution of sesquioxide in cold hydrochloric acid, but is decomposed by a gentle heat, and evolves chlorine.

The salts of manganese are numerous, and in a chemical view quite important. Sulphate of manganese is a very beautiful rose-coloured salt, isomorphous with sulphate of magnesia. It is used to give a fine brown dye to cloth, being decomposed by a solution of bleaching-powder, which forms the brown peroxide in the fibre of the stuffs.

XXXI. IRON.

Equivalent, 27·14. *Symbol*, Fe. *Density*, 7·8.

Iron is found malleable, and alloyed with nickel, in large masses of meteoric origin. One of these, discovered in Texas, weighs 1635 pounds, and is now in Yale College Cabinet. It is not certain that malleable iron of terrestrial origin has yet been discovered in nature. Iron is the most abundant and most important metal known to man. Its ores are found everywhere, and often in immediate connection with the coal and limestone necessary to reduce them to the metallic state. There is no soil, and scarcely any mineral, which does not contain some proportion of the oxide of iron.

Pure iron is difficult to prepare. The purest iron of commerce is always contaminated with a portion of silicon and carbon. When quite pure it is nearly white, quite soft, perfectly malleable, and the most tenacious of all metals. Its density is 7·8, which may be a little increased by hammering. It crystallizes in forms of the first class, as is beautifully shown in the crystalline structure of the meteoric iron. It fuses with extreme difficulty, first becoming soft or pasty, in which state it is *welded.* When intensely heated, in air or oxygen gas, it combines with oxygen, burning with brilliant light and numerous scintillations, and is converted into oxide of iron. Iron also attracts oxygen at common temperatures, forming rust. This does not happen in dry air; but the presence of moisture, and particularly of a little acid vapour, very much promotes its formation. Iron decomposes water very rapidily at a red heat, hydrogen being evolved. It is the chief medium of magnetism, being powerfully attracted by the magnet, and being also itself susceptible of this influence.

The chief ores of iron are, (1,) *brown hematite* or *hydrous peroxide,* from which the best iron is made. (2.) The *red hematite* and *specular iron* or *peroxide.* (3.) *Clay iron stone,* which is an impure carbonate of iron, or carbonate of iron with carbonate of lime and magnesia. This is the nodular ore of the coal formations. (4.) *Black* or *magnetic oxide of iron,* which is the ore of the iron mountains of Missouri and of Sweden.

The reduction of the ores of iron to the metallic state is performed in large furnaces, called *high or blast furnaces.* These are built of stone, in a conical form, 30 to 50 feet high, and lined internally with the most refractory fire-bricks. The furnace is divided into the throat, the fire-room (*b*), the boshes (*e*), (that portion sloping inward), the crucible (*t*), and the hearth(*h*), The blast of air—supplied from very large blowing cylinders—is introduced by two or three *tuyere* pipes (*a a*) near the bottom. In the most improved furnaces, the air-blast is heated by causing it to pass through a series of pipes in the upper portion of the furnace, so as to have a temperature of 500° or more when it enters the furnace. When the furnace is brought into action, it

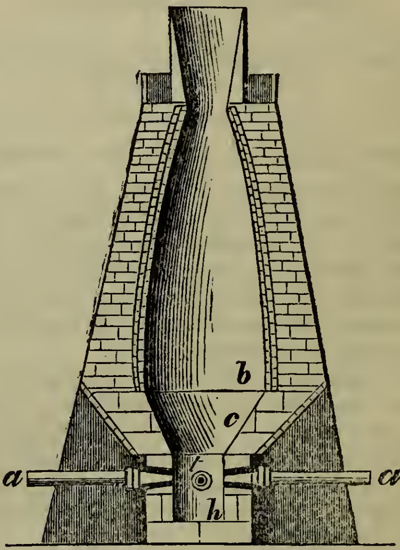

Fig. 9.

is first heated with coal only, for about 24 hours; and then is charged alternately with proper proportions of coal, roasted ore, and lime for flux, until it is quite full. When once brought into action, the blast is kept up for months or even years, until the furnace requires repairing. The ore is reduced on the boshes, and in the upper part of the crucible, and the melted metal collects on the hearth, covered by the molten flux, which is a glass formed by the fusion of the lime used and the earthy parts of the ore. From time to time, the iron is drawn off by an opening previously stopped with clay, and run into rude open moulds into sand. This is *cast iron*, and is of various qualities, according to the various character of the ore, and the working of the furnace. If malleable bar iron is wanted, the cast-iron is again melted, in what is called the puddling furnace, where it is stirred about by an iron rod, in contact with oxide of iron, and a current of heated carbonic oxide from the high furnace. It gradually becomes stiff and pasty from the burning out of the carbon, and from some molecular change not well understood. It is finally raised in a rude ball, and placed under the blows of a huge tilt-hammer, when the scoria is pressed out, and the particles made to cohere. It grows tenacious by a repetition of this process, being cut up and *piled* or *faggoted*, and re-heated several times, until it is finally made into tough and fibrous metal.

Steel is formed from refined iron by heating in contact with charcoal in close vessels (called cementation). It gains from one to two per cent. of carbon, becomes fusible, and can be *tempered* according to the use for which it is designed.

The oxides of iron are four; viz. (1,) protoxide, (FeO); (2,) sesquioxide, commonly called peroxide (Fe_2O_3); (3,) black oxide (magnetic oxide) (Fe_3O_4), and (4) ferric acid (FeO_3).

(1). *The Protoxide of Iron* is a powerful base, which is unknown in nature except in combination. It saturates acids completely, and is isomorphous with a large class of bodies, of which zinc and magnesia are examples. This oxide is thrown down from its solutions by potash, as a whitish bulky hydrate, that soon gains another dose of oxygen from the air, becoming brown and finally red. Its salts when soluble have a styptic taste like ink, and a greenish colour.

(2). *The Peroxide of Iron* is found native in the beautiful *specular iron* of Elba, and also in the red and brown *hematites.* It is slightly acted on by the magnet, and after ignition is almost insoluble in strong acids. It is isomorphous with alumina, and is generally associated with it in soils and many minerals. It is often of a brilliant red, and as *ochre* of various tints is much used as a pigment. Ammonia precipitates it from its solutions as a bulky red hydrate.

(3). *Black Oxide of Iron* is familiarly known in the common magnetic iron ore and native loadstone. It crystallizes in octahedrons. It forms no salts. The finery cinders or scales thrown off under the smith's hammer are this oxide.

(4). *Ferric Acid* is a new compound, corresponding to manganic acid, discovered by M. Fremy. A ferrate of potash is formed, when one part peroxide of iron and four parts of nitre are heated to full redness in a covered crucible for an hour. The ferrate of potash is dissolved out of the porous mass by ice-cold water. The solution has a deep amethystine colour, and is easily decomposed by heat. A soluble salt of baryta precipitates ferric acid as a beautiful red ferrate of baryta, which is permanent.

The chlorides of iron (FeCl and Fe_2Cl_3) correspond to the protoxide and sesquioxide (peroxide) of the same base. The latter is often used in medicine, and may be formed by saturating hydrochloric acid with freshly prepared peroxide of iron. The *protiodide* of iron is also a valuable medicine.

The sulphurets of iron are found native, and are well known as *pyrites.* The protosulphuret is easily formed artificially, by fusing sulphur with iron-filings; they ignite with a vivid combustion, and protosulphuret of iron is formed, which is much used in preparing sulphureted hydrogen. *Yellow iron pyrites* and *white iron pyrites* are dimorphous forms of the bisulphuret (FeS_2); the first is one of the most common of crystallized minerals. The magnetic sulphuret, *magnetic pyrites*, corresponds in composition to the magnetic oxide.

Of the salts of iron, the green vitrol or protosulphate (FeO,SO_3+7HO) is the most important. It is made in immense quantities, as at Stafford, Vermont, from the decomposition of iron pyrites, which furnishes both the acid and the base. This salt crystallizes beautifully, and is much used as the basis of all black dyes and ink, and in the manufacture of prussian blue. It is called *copperas* in the arts. Persulphate of iron is a sulphate of the peroxide ($Fe_2O_3+3SO_3$). *Carbonate of iron* occurs in nature as *spathic iron ore,* which is isomorphous with carbonate of lime. A variety of steel is made directly from this ore without cementation. It is formed artificially by precipitating a solution of sulphate by an alkaline carbonate, and is used in medicine.

The presence of a salt of iron is easily detected by the fine blue (prussian blue) formed on adding prussiate of potash to the solution. An infusion of galls gives a black colour (ink) to solutions of iron.

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THE STUDY OF CHEMISTRY WITH THE BLOWPIPE.—No. II.

PLATINA.

THIS metal is used in various forms. It is especially valuable, when the reducing agency of the charcoal would be prejudicial to the experiment. Platina spoons (Fig. 7) were some years since much used; but as the size of the spoon prevents the obtaining of a very high temperature, they have given place to the forceps. Platina was substituted for gold and silver, on account of its being less fusible than those metals; and when employed as a wire is so convenient a support, that it may be spoken of as indispensable. With a thin wire about two inches long, bent into the form of a hook at one end and moistened, any pulverized assay mixed with its flux may be taken up, and conveniently presented to the flame of the blowpipe.

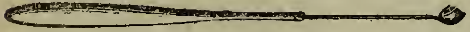

Fig. 7.

When it is required to determine the fusibility of a mineral, if it does not fly under intense heat, no support is so useful as the platina forceps (Fig. 8). Two thin plates of steel are fixed to a small iron block, thicker at one end than at the other. The extremities of the plates forming the pincers are covered with platina foil. These ends touch when closed, and are separated by pressing on a button, which, passing through one plate, is fastened to the surface of the opposite one. With these a small fragment of a mineral may be taken up. As the elasticity of the steel causes the ends of the forceps to close upon the assay, it will also be retained with a sufficient force, and may be conveniently presented to the flame. Platina being a bad conductor of heat, the forceps remains comparatively cool during the experiment.

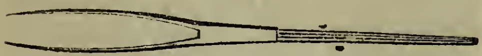

Fig. 8.

If the assay decrepitates or splits into small particles, the spoon forceps (Fig. 9) is employed. This instrument is also made of steel plates and platina. The extremities are laminæ of platina rounded at the end, and formed into cups; so that when closed they form a hollow globe, in which the assay is placed. In this instrument the steel plates are joined at their extremities; so that the platina ends remain open until the assay is introduced, and they are then kept together by a double sliding button.

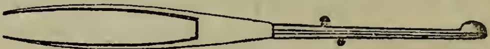

Fig. 9.

Dr. Wollaston was in the habit of using platina foil, which he cut into slips two inches long; and these he employed as supporters for the substances which do not decrepitate under high temperatures. Although these strips of platina foil are sometimes intensely heated at the end exposed to the flame, they may be held at the other without inconvenience. Substances in the metallic state, or reducible before the blowpipe without flux, must not be supported on platina foil; for it would alloy with the assay and fuse into holes.

When we wish to determine whether a substance gives off moisture in any blowpipe experiment, it must be inclosed in a glass matrass, formed in the shape of an oil flask. To ascertain whether an ore contains sulphur, or any other volatile substance, it must be submitted to a process called roasting in a glass tube, upon the sides of which it will be condensed. Cutting-pliars (Fig. 10), hammers, an agate pestal and mortar (Fig. 11), and the occasional use of a blacksmith's anvil, will be required by the mineralogist who studies his science with the aid of the blowpipe.

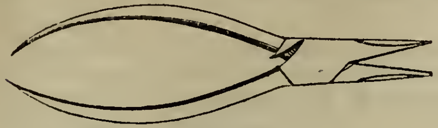

Fig. 10.

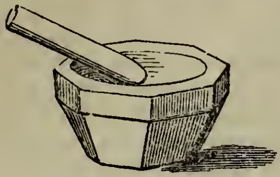

Fig. 11.

There are many substances upon which the blowpipe has no permanent effect, or at least the assay presents precisely the same appearance after ignition as it did before. When such substances are met with, they must be mixed with some other substance which acts as a re-agent; new characters being produced by the formation of new compounds, which detect the presence of elements with as much certainty as if they had been obtained in a perfectly pure state. These substances are called fluxes.

The fluxes used in the present day are the same as were employed by the early experimentalists—subcarbonate of soda, borate of soda, and the triple salt of phosphate of soda and ammonia, called for brevity's sake soda, borax, and salt of phosphorus. In reference to these substances we must make a few remarks.

Soda.—Either the carbonate or bicarbonate will answer the purpose of a flux, if free from sulphuric acid and perfectly pure. The bicarbonate is, from its greater insolubility, more easily prepared, and is therefore generally employed. The best way of obtaining it is to take a saturated solution of the subcarbonate of soda, and to pass through it a stream of carbonic acid gass; the bicarbonate will be precipitated in small crystals, which should be washed in cold distilled water. It may afterwards be heated to expel the water of crystallization, which process makes it less bulky, and preserves it from a watery fusion. This being done, it is only necessary to protect it from moisture.

Soda is employed as a flux for two purposes: to ascertain whether the substances combined with it are fusible or infusible, and to effect the reduction of the refractory metallic oxides. But it must be observed that many of the substances which combine with soda at a high temperature are infusible. With the acids, silica, and a few of the metallic oxides, it forms fusible compounds, which are, generally speaking, absorbed by charcoal.

"With regard to the use of soda," says Berzelius, "many minutiæ are to be observed. We take up the necessary quantity with the point of a small knife, previously moistened by the mouth to make the powder adhere to it. It is then applied to the palm of the left hand, and, if necessary, moistened again, so as to form it into a coherent mass. If the substance to be tried be pulverulent, it must be kneaded in the hand with soda; but if it be in the form of a spangle or grain, the soda is applied to its surface: it is then heated on charcoal, at first to dryness, and afterwards until it fuses. It commonly happens that the soda is absorbed by the charcoal the instant after it is melted; but this does not prevent its effect on the assay: for if it be fusible with the soda, it soon after pumps it up again, a continued effervescence appears at the surface, its edges become round, and the whole is transformed into a fluid glass globule. If the assay be infusible in soda, but decomposable by it, it is perceived to swell up by degrees, and change its appearance without fusing. Before we pronounce on the infusibility of any substance with soda, under the action of the blowpipe, we must always try a mixture of the flux with the substance reduced to powder. If we take too little soda, a part of the matter remains solid, and the rest forms a transparent vitreous covering round it; if we take too much, the glass globule becomes opaque on cooling."

The reduction of metallic oxides is easily effected by heating them with soda, even when they prove extremely refractory without a flux. Thus, if a particle of the oxide of tin be heated on charcoal, its reduction is effected with great difficulty, and only by a skilful operator; but if a little soda be added, the reduction is easily accomplished, and so completely, that if the oxide be pure, it will be wholly converted into reguline tin.

But if the metallic substance should contain some foreign substance, incapable of reduction, it will be more difficult to reduce the metal, and be sometimes quite impracticable. When this happens, the addition of a little borax will assist in dissolving the foreign matter, and the reduction will afterwards be easily accomplished.

If the metallic oxide should be united to a comparatively large quantity of irreducible matter, the assay is made for a reducible matter in the following manner, as described by Gahn :—

The assay being reduced to powder, is kneaded in the palm of the hand with soda, and moistened so as to form a coherent mass. It is then placed on the charcoal, and exposed to a good reducing heat; more soda is gradually added, and the heat renewed, until the entire mass has been absorbed by the charcoal. The ignition of the charcoal ceasing, that portion of it which contains the absorbed mass is removed with a knife, and reduced to a fine powder in an agate mortar. This powder is then washed with water, by a process suggested by Wollaston. A phial containing a little water is accurately closed with a cork, perforated with a capillary glass tube. When the bottle is inverted, the heat of the hand expands the inclosed air, and a capillary stream of water is forced upon the substance to be washed. The grinding and washing should be frequently repeated —the latter process must be carefully done. If the smallest portion of reducible metal exist, it will be found, if fusible and malleable, at the bottom of the mortar in the form of minute brilliant leaves; but if brittle, and incapable of fusion, as a powder. In either case the presence of a metal will be detected by the friction against the agate mortar.

Borax is a compound of boracic acid and soda. The borax of commerce cannot be used in experiments with the blowpipe, till it has been dissolved in water and recrystallised. This is necessary to free it from those metallic impurities derived from the vessels in which it is refined.

Borax is employed in the solution or fusion of a great number of substances; but as a guide for its application, it will be only necessary, at present, to say, that when the assay is crushed, it should be added when the borax begins to swell. In the use of this substance, the chemist observes every phenomenon—whether the mineral under experiment fuses readily or with difficulty—slowly or rapidly—quietly or with effervescence—whether the glass produced by the fusion be coloured or colourless—whether the colour in the oxidating flame differs from that in the reducing—whether the colour increases or diminishes by cooling—and, as a not less important supplementary observation, whether the glass preserve or lose its transparency.

Salt of Phosphorus.—This salt may be produced in the following manner :—Dissolve eight parts of sal-ammoniac (muriate of ammonia) in a small quantity of boiling water, and add fifty parts of the crystallised phosphate of soda; reduce them into a liquid state, and filter the mixture when boiling. The triple phosphorate will be produced by crystallisation as the solution cools.

This salt, when heated by the blowpipe flame, boils up, intermixes, and gives off ammonia, while the acidulous phosphate of soda remaining, forms, as it cools, a transparent colourless glass. Its effects are chiefly to be traced to the free phosphoric acid, which dissolves the basis of salts, and forms with them triple salts, more or less fusible. This flux is, therefore, peculiarly applicable to the examination of metallic oxides, the characteristic colours of which it develops better than borax. The advantage of this salt over the phosphoric acid is, that it is less costly, and not so deliquescent as the pure acid.

The salt of phosphorus has a repellent influence on acids: those that are volatile, sublime; and those that are fixed remain in the mass, either dividing the base with the phosphoric acid, or yielding it up altogether. In the latter case, the fixed acids remain suspended in the glass without dissolving. Hence it is a very good test for the silicates, as it sets the silica free, so that it appears liquified in the salt resembling a gelatinous mass.

Other fluxes and re-agents are sometimes required; but as they are employed only in particular or special cases, any remarks upon them may be deferred until the instances in which they are used come under notice.

The following general remarks, upon the mode of making experiments with the blowpipe, may be useful:—Having detached a small fragment of the mineral to be examined, with a hammer, or the steel end of a forceps, it must be first heated alone, and the effects carefully observed. A piece about the size of a pin's head will be sufficiently large, if the changes it undergoes can be observed even with a lens; for the smaller the fragment, the more effectual will be the re-agency of the heat. The principal phenomena to be looked for are, phosphorescence, ebullition, intumescence, decrepitation, fusibility, and the exhalation of odour. When an odour is produced, it is necessary to ascertain whether it be sulphurous or alliaceous; the latter is produced by the volatilization of metallic arsenic. It must also be observed whether the fused mass be a transparent glass, an opaque enamel, or a bead of metal.

Take a particle of any mineral in the platina forceps, and when the flame is directed on it you will immediately discover whether it decrepitates or is fused. If decrepitation takes place, inclose it in the spoon forceps, and expose it to a strong heat. This process generally deprives it of that property; and it may afterwards be heated on charcoal, and examined for odour and other properties. It may then be treated with a flux. In the examination of the ores, the metal may be ascertained by the colour of the fused mass.

Before we proceed further, it may be desirable to describe a few experiments which may be performed without much difficulty with the blowpipe. They are intended for the use of the student who has resolved to become an expert manipulator; and they will serve the purpose of giving facility to the hand, and quickness of observation, while they convey much valuable and necessary information.

Mercury.—Put a small quantity of vermilion, which is a compound of sulphur and mercury, mixed with a little carbonate of soda, into a small glass tube closed at one end. Heat the bottom of the tube by the flame of the blowpipe, and a chemical composition will be quickly observed,—the mercury will be liberated, and the sulphur will unite with the soda, producing the sulphuret of soda. The brilliant, little metallic globules at the top of the tube are produced by the sublimation of the mercury. If the substance at the bottom of the tube be touched with an acid, sulphureted hydrogen gas, at once detected by its unpleasant odour, will be given off.

Cobalt.—The three following experiments may be performed with any soluble salt of cobalt: either the nitrate or hydrochlorate will probably be chosen:—

1. Place a drop of either of the above mentioned salts of cobalt upon a small portion of manganese, and expose them to the blowpipe flame upon a slip of platina foil, till a red heat is obtained. A delicate rose-coloured powder will be produced: this is a compound of the oxide of cobalt and magnesia.

2. If a small piece of alum be dissolved in water, and a few drops of ammonia be added to the solution, a white gelatinous precipitate will be produced. Wash and dry a portion of this precipitate; place a small quantity on a piece of platina foil, and saturate it with the solution of cobalt. Raise it to a bright red heat under the blowpipe flame, and an opaque ultramarine blue will be produced,

3. Take a small crook of platina wire with a long stem; fix the straight end in a cork, and dip the crook, when moistened, into powdered borax. When this is exposed to the flame of the blowpipe it will become a vitreous, transparent bead. If this bead be touched with cobalt, or any solution or preparation of that metal, and raised to a white heat in the outer cone of the flame, the product will be a transparent glass of a saphirine or cerulean blue.

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SAYINGS OF WISE MEN.

Books.—Some books are to be tasted, others to be swallowed, and some few to be chewed and digested: that is, some books are to be read only in parts; others to be read, but not curiously; and some few to be read wholly, and with diligence and attention. Some books also may be read by deputy, and extracts made of them by others; but that should be only in the less important arguments, and the meaner sort of books; else distilled books are like common distilled waters, flashy things.—*Lord Bacon.*

Indulgence.—Whoever has watched children with care, has noticed that any passion or feeling becomes stronger by repetition. In the first instance, it is dim and feeble; in the second, it is more vivid and vigorous. By degrees it grows stronger; and when, at length, it has become habitual, it is not only very apt and ready to return, but, like a vicious horse, it seizes the bit, and rushes forward in defiance of all control. Indulgence is the great principle of nutriment and culture to human passion. It is as the sun and rain and rich soil to vegetation.—*S. G. Goodrich.*

Time.—It is said that Sir Walter Raleigh wrote the following lines on a blank leaf of his Bible the night before his execution:—

Even such is time, that takes on trust
Our youth, our joys, our all we have,
And pays us but with age and dust:
Who, in the dark and silent grave,
When we have wandered all our ways,
Shuts up the story of our days.

Get Knowledge.—Fetch down some knowledge from the clouds, the stars, the sun, the moon, and the revolutions of all the planets. Dig, and draw up some valuable meditations from the depths of the earth; and search them through the vast oceans of water. Extract some intellectual improvement from the minerals and metals; from the wonders of nature among the vegetables and herbs, trees and flowers. Learn some lessons from the birds and the beasts, and the meanest insects. Read the wisdom of God, and His admirable contrivance in them all: read His almighty power, His rich and various goodness, in all the works of His hands.—*Dr. Watts.*

Industry.—In youth the habits of industry are most easily acquired; in youth the incentives to it are strong, from ambition and from duty, from emulation and hope, from all the prospects which the beginning of life affords. If, dead to these calls, you already languish in slothful inaction, what will be able to quicken the more sluggish current of advancing years? Industry is not only the instrument of improvement, but the foundation of pleasure. Nothing is so opposite to the true enjoyment of life as the relaxed and feeble state of an indolent mind. He who is a stranger to industry may possess, but he cannot enjoy. For it is labour only which gives the relish to pleasure. It is the appointed vehicle of every good man. It is the indispensable condition of our possessing a sound mind in a sound body.—*Blair.*

Small Unkindnesses:—

Since trifles make the sum of human things,
And half our misery from foibles springs—
Since life's best joys consist in peace and ease,
And few can save or serve, but all can please—
Oh! let the ungentle spirit learn from hence,
A small unkindness is a great offence:
Large bounties to bestow we wish in vain,
But all may shun the guilt of giving pain.
—*Anonymous.*

Envy.—Envy is so base and detestable, so vile in its original, and so pernicious in its effects, that the predominance of almost any other quality is to be desired. It is one of those lawless enemies of society, against which poisoned arrows may honestly be used. Let it therefore be constantly remembered, that whoever envies another, confesses his inferiority; and let those be reformed by their pride, who have lost their virtue.—*Dr. Johnson.*

Health.—The common ingredients of health and long life are,—

Great temperance, open air,
Easy labour, little care.
—*Sir Philip Sidney.*

Vanity.—The most delicious music is the praise of one's-self; the most beautiful object is the work of one's own hands.—*Tatler.*

Cheerfulness.—I have always preferred cheerfulness to mirth. The latter I consider as an act, the former as a habit of mind. Mirth is short and transient, cheerfulness fixed and permanent. Those are often raised to the greatest transports of mirth who are subject to the greatest depressions of melancholy; on the contrary, cheerfulness, though it does not give the mind such an exquisite gladness, prevents us from falling into any depths of sorrow.

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> "The withered leaves bestrew the garden path,
> Made miry with the fall of fleeting showers;
> The sun emits a feeble ray, which hath
> No power to warm or cheer the gloomy hours;
> The robin only sings among the bowers,
> Now bare and desolate, his simple lay;
> All other birds are mute and sad, or they
> Have flitted with the spring and summer flowers.
> Yet are the borders not entirely bare,
> For many-tinted asters still remain,
> And bright chrysanthemums nod here and there
> Their heads, to chilling blast and pelting rain."
>
> H. G. Adams.

Gloomy November has come at last, with its fogs, its nipping winds blustering through many a half-leafless hedge, and days of drizzling rain, when the sun smiles sadly through the sable clouds that hang over Nature, imparting a sadness to her, as if she mourned the decline of the year. And oh! how bright a year it has been to many, but how sad to others,—too sad for them to dwell upon.

Yet such is life; chequered in its path,—strewn with sweets and bitters, with happiness and sorrow.

"When are we happiest, then? Oh! when resigned
To whatsoe'er our cup of life may brim;
When we can know ourselves but weak and blind
Creatures of earth! and trust alone in Him
Who giveth in His mercy joy or pain:
Oh! we are happiest then."

November is, literally, the ninth month of the year—its name being derived from the Latin words *novem*, nine, and *imber*, a shower; but when January and February were added to the calendar, it became the eleventh month, retaining its original name and number of days—thirty.

Our Saxon ancestors called this month *Blot monath*, or slaughter month, because, as food for the cattle was scarce during the winter season, it was customary for them to kill and salt most of their winter meat during this month. The name is derived from the Saxon word *Blotan*, to kill or slay. They also called it *Wint monath*, or wind month, on account of the tempestuous weather which prevails at this period of the year, when the wind strips the trees of their few remaining leaves, so that the traveller, as he journeys along, sees these

"Thin dancers upon air
Go eddying round."

The synonymes of the month are as follows—in Latin, *November*; French, *Novembre*; Italian, *Novembre*; and Portuguese, *Novembro*.

This month was allegorically represented as a young man dressed in clothes the colour of the leaves when they begin to fall; his head was crowned with a garland of olives with the fruit; in his hands he held bunches of turnips and parsnips, symbolical of the produce of the earth during this month; and behind him was the sign of *Sagittarius*, the Archer, in allusion to the sun entering that constellation on the 22nd of the month.

The chronology of November, containing many important memoranda, is given below.

CALENDAR FOR NOVEMBER.

1. *All Saints.*—Earthquake at Lisbon 1755.
2. R. Hooker died 1600.—Henry II. landed in Ireland 1172.
3. Bishop Lowth died 1787.
4. The Prince of Orange, afterwards King William, landed, 1688.
5. *Gunpowder Plot* 1605.—Battle of Jemappe 1792.
6. *Leonard.*—James Gregory born 1638.
7. John Eyrle died 1724.
8. Cortes entered Mexico 1519.—Milton died 1674.
9. Archbishop Sheldon died 1677.
10. Martin Luther born 1483.—Schiller born 1759.
11. *St. Martin.*—French Republic established 1848.
12. Canute "the Great" died 1036.
13. *Britius.*—George Fox died 1690.
14. Jacob Bryant died 1804.
15. *Machutus.*—Cowper born 1731.—Lavater born 1741.
16. Dr. Hawkesworth died 1773.—James Fergusson died 1776.
17. Queen Elizabeth acceded to the throne 1558.
18. P. P. Rubens born 1577.—Sir David Wilkie born 1785.
19. Romney, 50 guns, lost 1804.
20. James Hogg died, 1835.
21. Lord Hawke's victory 1759.
22. *St. Cecilia.*—Insurrection at Lyons 1831.
23. Sir John Barrow died 1848.
24. Lawrence Sterne born 1713.
25. Dr. Isaac Watts died 1748.
26. *St. Stephen.*
27. Bishop Lowth born 1710.
28. Cardinal Wolsey died 1530.
29. John Ray born 1628.—Oliver Goldsmith born 1731.
30. *St. Andrew.*—Swift born 1667.

The Red Letter Days of the month are interesting and remarkable, being as follows:—

1*st.*—"*All Saints*" is a festival instituted by Boniface IV. when he was allowed by the Emperor Phocas to convert the Pantheon at Rome into a Christian church. It was originally celebrated on the 12th of May in honour of the Virgin Mary and all Martyrs, but was afterwards ordered to be kept upon November 1st. Many curious customs are still practised in various parts of Great Britain upon this day, similar to the ceremonies of Halloween.*

2*nd.*—"*All Souls*" is a festival of the Romish Church, held in commemoration of the Faithful Departed, and is accounted a very solemn festival, being celebrated with masses and formal ceremonies adapted and arranged for the purpose. Brady informs us, that "Odilon, Abbot of Cluny, in the 9th century, first enjoined the ceremony of praying for the dead on this day in his own monastery; and the like practice was partially adopted by other religious houses, until the year 998, when it was established as a general festival throughout the western churches.

(*To be continued.*)

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* For an account of these ceremonies see p. 179.

EDUCATIONAL AND SCHOLASTIC MATTERS.

SCHOOLMASTERS, AND THE COLLEGE OF PRECEPTORS.

The Council of the College of Preceptors has recently issued a circular addressed "To all properly qualified SCHOOLMASTERS and TEACHERS in the United Kingdom, and the various dependencies of the British Empire." The circular states that it is one of the objects contemplated by the College of Preceptors to call upon the Legislature to declare that no person, whether male or female, shall capriciously, and without proof of proper qualification, become a teacher of others; and there can be no doubt that both society and the legislature are ready to support such a declaration, when the proper time arrives.

It has been asked, with some degree of propriety, why the schoolmasters of this country do not one and all join their own incorporated body—the College of Preceptors—in order that the profession may take its position and standing in society, similar to the medical, the legal, and other learned professions. Perhaps it may be the result of indifference, or of jealousy, or private interest. If so, let it be borne in mind, that education has now become a science; and it only requires the enrolment of the Teachers of this country, according to the general plans of the College of Preceptors, to be advanced to that state of perfection which years of legislation would fail to accomplish.

Many teachers of the old school are apt to imagine that the College of Preceptors is hostile to their interests; and some of the younger ones seem to think that it is very hard that they should be required to pass an examination: they want neither the college, its examinations, nor its examiners. One of these, in a very secluded village, who had never passed any Board of Examiners, openly stated that he knew more than all the board of examiners together, and yet he would not allow his name to be proposed as an improvement to the list!

Some few years ago there were many charlatans who would teach any subject or language whatever, without professing to know a word of it, and they found fools who were willing to be led by such blind guides—but such pretenders cannot find much countenance now. The public are alive to the advantages of a skilled teacher as well as of a skilled artisan; and it is only a *rara avis* of a teacher who would now venture to make such pretensions.

The public appear much more alive to the advantages of having able teachers than the schoolmasters themselves. They demand that every teacher should be compelled to undergo an examination before a competent Board; and since they cannot obtain them by other means, certificated masters are sought for out of the National School Teachers, and receive appointments as private tutors, or assistants in first-class schools. The public now require competency and ability as a teacher from the principal of every school, and they will remunerate him accordingly. His diploma, signed by a competent Board of Examiners will prove the amount of his acquirements; the School Examiner will test his teaching; and the success of his pupils on entering life will put the seal to his qualifications.

The present time (says the Educational Times) seems to promise the greatest hopes of success. The School Assistant has already proved the possibility of his part being effected: and the rising Principles will certainly not be content to enter the field of competition under a load of doubt when they can so easily verify their qualifications. What the public opinion on the subject is, will be seen very shortly, when the matter is brought before the House of Commons; but as far as personal opportunities afford a criterion, it is evident that the public of the metropolis are highly desirous for the enactment of some legislative measure which may afford the public a guarantee for the proper qualification of every man who undertakes the duties of an educator.

The second annual dinner of the West London Local Board of the College of Preceptors, was held on the 12th of October, at the Pier Hotel, Cheyne Walk, Chelsea; when the Dean of the College, the Rev. Dr. Wilson, presided; and in proposing prosperity to the College of Preceptors, delivered the following sentiments, as to the educational objects of the institution:—"Many persons asked what was meant by this term. It meant this, that an examination at the college, and a certificate from the board of that college, was an assurance that the person who received the certificate was a person qualified to teach the youthful portion of the community those things that were necessary to make them fit and proper members of society. It was gratifying to know that the instructors of youth were beginning to be looked upon as really deserving of a status in society equal with the members of the church, the bar, and the medical profession. They had succeeded in this object to a certain extent. They had obtained a charter of incorporation—they had served their seven years' apprenticeship, and they were now in every way qualified to be considered as guides in the education of youth, as regarded their interests here and hereafter. The rev. chairman then referred to the system of education pursued from Socrates down to the present time, and expressed his belief that the College of Preceptors was destined to become the representative of the philosophers of old. He hoped they would soon be in a position to say that no man or woman would be allowed to go forth as a teacher of youth, unless he or she had a certificate of competence from the college.

METEOROLOGICAL EDUCATION AND THE LAWSON OBSERVATORY.

We believe that it is now settled that the town of Nottingham is to be the chosen locale for the Lawson Observatory, which has been presented to the public by the liberal-minded proprietor. The Lords of the Treasury have granted £2,000 towards the fund, on certain conditions, which are thus explained in a letter written to the committee by Sir Charles Trevelyan :—" It is strongly stated that, in regard to meteorological pursuits and inquiries, such an establishment might prove of the greatest value in a national point of view ; and, moreover, it is shown by Sir John Herschel that Nottingham possesses some peculiar advantages for observations of this kind. It is represented that, important for the purposes of agriculture and other national objects as this branch of science is compared with astronomy, it is, nevertheless, much behind, and has been comparatively neglected. With regard to this branch of the subject, my Lords advert to the continued efforts which are about to be made by the Government of the United States, represented by Lieut. Maury, and by her Majesty's Government, under the sanction of this Board, in order to obtain meteorological observations at sea for maritime purposes; and although their Lordships cannot look for much aid to that particular object, from observations made at Nottingham, yet they will not be wholly without value, even in relation thereto. My Lords are, however, prepared to look for more important national advantages, as regards the interests of agriculture and other pursuits, which are much affected by climate and weather from such an establishment at Nottingham, provided meteorology may be looked to as the main and most important object to be attained by the establishment."

CROSBY HALL EDUCATIONAL CLASSES.

The 5th annual report of this laudable association contains some interesting information. It now consists of about 600 young men, whose course of tuition is arranged in twenty-six classes; and every week a lecture is delivered by some gentleman eminently qualified to instruct in the subject he selects for illustration. This association forms an interesting feature in the educational movements of the day. Its origin deserves notice. In 1848, some of the friends of education in London published a practical prospectus, and opened six or seven evening classes in two localities in London. The next year they extended their operations; and through the instrumentality of much free help opened more classes in several of the National and Ward Schools, even as far as Lambeth and Westminster. They next obtained the patronage of his Royal Highness the Prince Albert and other valued names; and in several places, but particularly at Crosby Hall, in Bishopsgate, delivered courses of lectures that vindicated their pretensions to form a Literary Society, and gave some sign of their attempting science. In 1852 they appointed a Council of Examiners, and invited their members to an honorary examination; and finding the plan succeed, they have this year promised certificates to those who satisfied the examiners. The central point of their proceedings is Crosby Hall, in Bishopsgate Street, where is a suitable reading-room, and a large circulating library, placed at the service of the members, and all at a very moderate price. For 10s. 6d. a year a young man may read his paper and the magazines, have the use of a well-lighted room, with the run of a valuable library all the year round; with class instruction in the subject he most requires, one evening a week, under an eminent teacher, for nine months in the year ; and, at the very least, thirty-three admirable lectures on popular subjects.

ADMIRALTY EDUCATION.

Sir James Graham has now altogether abolished the School of Mathematics and Naval Construction, Portsmouth, of which, during the five years of its existence, the Rev. Dr. Woolley was the Principal. It had been long announced by the Admiralty, that in September Dr. Woolley would be advanced to another office, and that the government of the Central School would be transferred to one of the Dockyard schoolmasters, Mr. Rawson, of Portsmouth. We understand that the pupils belonging to the school at the time of its discontinuation have been removed to a kind of upper class in the Portsmouth Dockyard School.

INDUSTRIAL SCHOOL AT PLASHET, ESSEX.

This school is intended as a model establishment, and is, perhaps, the first of the kind erected by a single parish. A short time ago, the directors of the poor of the parish of St. George's-in-the-East celebrated the first anniversary of laying the first stone, by the holding of a fancy fair, and the examination of the children maintained and educated in that institution. The establishment is worthy of attention. It stands upon seventeen acres of ground, and is intended to accommodate 400 children. There are at present in the school 250 children—viz. 100 boys, and 150 girls, besides 50 infants. In connection with the school a model farm is maintained, upon which there are six cows, 100 pigs, and two horses ; and the children are alternately instructed in out-door and field-work. The arrangements of the establishment are very complete, consisting of an infirmary, plunging and other baths, three playgrounds (the paving of which cost £1000), steam-cooking apparatus, &c.; the whole erected at a cost of £17,000.

ART EDUCATION FOR SCHOOLS.

A movement is now making in the educational world to effect the introduction of art-instruction in our elementary schools. It has hitherto been a defect which all reflecting men have long regretted, but which is at length likely to be remedied. It is not long ago that an aggregate meeting of the teachers of elementary schools in the metropolis was held in Shaftesbury Hall, Aldersgate Street, for the purpose of adopting resolutions for effectually introducing the rudiments of art and science into elementary schools. Upwards of 150 teachers of both sexes were present. Mr. Burchett, head master of the Marlborough-house-school, presided, and addressed the meeting, after which a report of preliminary procedure was read, and resolutions to the following effect were passed,—namely, that elementary school teachers should have the means afforded to them of becoming practically acquainted with the plans proposed by the Department of Practical Art; that the meeting appreciated very highly the announcement that classes would be opened by the Department of Practical Art for giving instruction to teachers, and that it was of urgent necessity that classes should be formed in the centre of the City, and, if possible, connected with a museum of objects of interest to teachers of elementary schools, and especially in reference to science and art. A committee of three was then appointed to carry out the preceding resolutions, and superintend the arrangements to be adopted for establishing an educational museum in the metropolis.

EDUCATIONAL USES OF MUSEUMS.

At the late opening for the Session of the Museum of Practical Geology, in Jermyn Street, Professor Forbes delivered an interesting discourse on the Educational Uses of Museums. The lecturer animadverted on the unfortunate circumstance, that some of our Museums have no system of public teaching attached to them, being mere collections of dry bones—curious to a few, but useless to the many. He made some observations on the state of some of our provincial Museums; and urged the policy of each town or city aspiring to establish a Museum for the use of its inhabitants—paying great attention to the scientific features of its own locality, and providing for a due illustration of its products and peculiarities.

"THE CATHOLIC" UNIVERSITY IN IRELAND.

The report of the committee of the Catholic University of Ireland just issued states, that up to the beginning of this year a sum of £36,000 had been subscribed. Of this sum, £22,000 has been raised in Ireland; and it is expected that when all the "parochial" collections shall have been completed, the contribution of Ireland towards the new undertaking will not be less than £40,000. From the United States the contribution is £7750; from England, £3568; from British Southern America, France, and India together, only £993.

GENERAL ASSEMBLY'S EDUCATION SCHEME.

The number of persons upwards of six years of age, in the Highlands and Islands, unable to read, was ascertained, in 1833, to be not less than 83,397; the number of these betwixt six and twenty years of age being 28,073. By the operation of this scheme, at least 120 schools have been added in the Highlands and Islands; and the number of persons in these districts, unable to read, has been, in consequence, greatly diminished. Seventy-two of the Highland schools are in parishes extending in length fifteen miles or upwards; forty-eight of these being in parishes the length of which varies from twenty to seventy miles. During last year, between 16,000 and 17,000 children received instruction at the 177 Assembly Schools, which are as nearly as possible on the pattern of the parish schools.

SCHOOL DIET IN FRANCE.

Most people are aware that the consumption of animal food in France is much less per head than it is in England; but one could hardly have supposed that the difference was so great as would appear from the dietary fixed by the Minister of Public Instruction, the other day, for the pupils in the Lycées in Paris. In consequence of complaints that the pupils did not receive a sufficient amount of nutritious diet for their perfect physical and intellectual development, a commission of physicians was lately appointed to examine the quantity and quality of the food supplied. The result of their inquiry is, that the pupils have not been receiving a sufficient quantity of meat, and therefore the Minister of Public Instruction has ordered a larger allowance for them in future. The senior pupils are now to have 2½ ounces of meat for dinner, the middle class rather more than 2 ounces each, and the juniors about 1¾ ounces each. But even this imimproved dietary is much inferior to that of the inmates of most of our prisons. From the Eighteenth Report of the Inspectors of Prisons, we find, that in the regular dietary of male prisoners above fourteen years of age, the allowance of meat is 4 ounces to each person, and to women and children 3 ounces each. In English establishments of a similar nature to those in Paris, the daily average consumption of meat would not be less than 8 ounces per head; more than three times the quantity allowed to the big boys in the Paris colleges. With such a difference in the dietaries of the two nations, it is no wonder that England should take the lead in whatever requires force of thought or action.

THE EDITOR AND HIS CORRESPONDENTS.

Academics—A Classical Student.—The name is so familiar to classical readers that we feel rather surprised at the question. "Academics" was the name given to those philosophers who adhered to the doctrines of Socrates and Plato, concerning uncertainty of knowledge and incomprehensibility of truth. Their original maxim was, "I am certain of nothing; no, not even that I know nothing." They therefore insisted that the mind ought always to remain in suspense. This doctrine, to doubt and distrust at every step in our researches after truth, was inculcated among his disciples by Plato, not to deter them from the pursuit of knowledge, or to keep them fluctuating always between truth and error, but to curb them from the presumptuous and rash decisions to which young minds are subjected in their studies and arguments, and to engage them to attain a more perfect understanding of things, and to avoid error, by duly examining everything with candour and impartiality; according to the advice of the inspired writer, who adviseth that "we prove all things, and hold fast what we shall find to be good;" so that whatever might be the sceptical notions of some philosophers, the Academics only doubted, in order that their determinations afterwards might be the more certain and unalterable.

Inquirer.—Almagest is the name of a celebrated book, composed by Ptolemy, consisting of numerous observations and problems of the ancients, respecting geometry and astronomy. The word is compounded of the Greek *μεγιστη*, greatest, and the Arabic particle *al*. The work was called, in the original, *συνταξις μεγιστη*, or the greatest collection; and when the Arabs translated it into their own tongue, about the year 800, by order of the caliph Al Maimon, they gave it the name of *Almaghesti*, from the latter Greek word. The almagest of Ptolemy was always extremely rare, and considered as "omni auro pretiosior," from its illustrating many curious mathematical points in astronomy, and elucidating sacred and profane chronology.

Alchymista.—If you write to Mr. G. W. Smith, Secretary of the Pharmaceutical Society, No. 17, Bloomsbury Square, he will send you a prospectus, or programme, of the conditions necessary for a druggist becoming a member of the Society. The most useful works we recollect on the subject are Black's "Pharmaceutical Student's Guide," Jones's "Manual of Pharmacology," and Kane's "Practical Pharmacy."

"A first class Certificated Master" must attend the usual examinations of the College of Preceptors, if he wishes to obtain the degrees offered by the College.

J. M. W.—The little particles prefixed to the aceates, oxides, &c., of chemistry, as *proto*, *per*, &c., are intended to express the relative strength of the compounds. Thus, when the same element unites with oxygen in more than one proportion, forming two or more oxides, then they are distinguished by the Greek prefix, *proto* (*protos*, first), applied to that body which has the least portion of oxygen, which is called the *protoxide; deuto* (*deuteros*, second), is prefixed to the next degree of oxidation, giving us the term *deutoxide; trito* (*tritos*, third), to the body containing still more oxygen than the deutoxide. The oxide which contains the largest dose of oxygen with which the body is known to unite is also called the *peroxide*, from the Latin *per*, which is a particle of intensity in that language. Thus there are two oxides of hydrogen, the protoxide (water) and the peroxide; there are three oxides of manganese—the protoxide, the deutoxide, and the peroxide of manganese. Some oxides are formed in the proportion of 2 to 3, or once and a half. Such oxides are distinguished by the term *sesquioxides*, from the numeral *sesqui* (once and a half). Certain inferior oxides are called *suboxides*.

Sholasticus.—The Retiarii (noticed in page 224) in their engagements with the Myrmillones, made use of a net, in which they endeavoured to entangle their adversaries, and sang during the fight, "Non te peto, piscem peto; quid me fugis, Galle?" (I aim not at thee, but I aim at thy fish; why dost thou shun me, O Gaul?) The Myrmillones, with whom they fought, were called Galli, because they wore Gallic armour. They were also named *Secutores*. This kind of gladiators was suppressed by Caligula.

T. Gibbon inquires "the reason why so many words in the Bible are printed in italics?" These italic words generally consist of the auxiliary verbs, as *an*, *are*, *was*, &c., which in the original are not written, but understood. It is the peculiar genius of the ancient languages, especially Hebrew, Greek, and Latin, to omit the minor words of a sentence; but as these omissions would sometimes give rise to obscurity, the translators have generally supplied them, and, for the sake of distinction, printed them in italics. Thus in the Gospel of St. John, i. 6—"There was a man sent from God, whose name *was* John." The word printed in italic is omitted in the original Greek.

Walter Lewis.—It is customary, as a matter of courtesy, to address a solicitor, and indeed every professional man, with the title of *Esquire*, although he is not legally entitled to it. His ancient and legitimate title is that of *Gentleman*, which now appears to have fallen into desuetude.

NATURAL PHILOSOPHY.

Second Division.

SECTION IX.—THE PROPERTIES OF HEAT.

THERMOTICS.

CHAPTER XLVIII.

THE PROPERTIES OF HEAT.

Relations of Light and Heat—Mode of Determining the Amount of Heat—The Mercurial Thermometer—Its Fixed Points—Fahrenheit's, Centigrade, Reaumur's Thermometers—The Gas Thermometer—Differential Thermometer—Solid Thermometers—Comparative Expansion of Gases, Liquids, and Solids.

Whatever may be the true cause of light, whether it be undulations in an ethereal medium, or particles emitted with great velocity by shining bodies, observation has clearly proved that heat is closely allied to it.

When a body is brought to a very high temperature, and then allowed to cool in a dark place, though it might be white-hot at first it very soon becomes invisible, losing its light apparently in the same way that it loses its heat. And we shall hereafter find the rays of heat which thus escape from it may be reflected, refracted, inflected, and polarised, just as though they were rays of light.

In its general relations heat is of the utmost importance in the system of nature. The existence of life, both vegetable and animal, is dependent on it; it determines the dimensions of all objects, regulates the form they assume, and is more or less concerned in every chemical change that takes place.

Every object to which we have access possesses a certain amount of heat, and so long as it remains at common temperatures, may be touched without pain; but if a larger quantity of heat is given to it, it assumes qualities that are wholly new, and if touched it burns.

To determine, therefore, with precision the quantity of heat which is present in a body when it exhibits any particular phenomenon, it is necessary that we should be furnished with some means of effecting its measurement. Instruments intended for this purpose are called thermometers.

[Much doubt exists respecting the date of the invention of the thermometer, and the originator is unknown; but it is generally considered to have been invented about the beginning of the 17th century. Vast improvements have been made in its construction since the period of its adoption. To the astronomer Röemer is due the merit of having proposed mercury as the thermometer fluid, instead of the linseed oil used by Newton. About 1724 Fahrenheit considerably improved the instrument; but since then little or no improvement has taken place in it.—W. T. K.]

Of thermometers we have several different kinds. Some are made of solid substances, others of liquids, and others of gases. With a few exceptions they all depend on the same principle—the expansion which ensues in all bodies as their temperature rises.

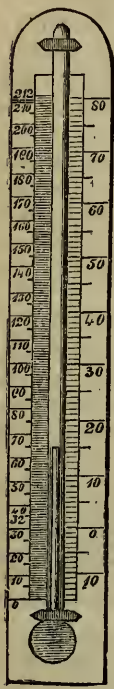

Fig. 296.

Of these the mercurial thermometer is the most common, and for the purpose of science the most generally available. It consists of a glass tube, Fig. 296, with a bulb on its lower extremity. The entire bulb and part of the tube are filled with quicksilver, and the rest of the tube, the extremity of which is closed, contains a vacuum. This glass portion is fastened in an appropriate manner, upon a scale of ivory or metal, which bears divisions, and the thermometer is said to be at that particular degree against which its quicksilver stands on the scale.

If we take the bulb of such an instrument in the hand, the quicksilver immediately begins to rise in the tube, and finally is stationary at some particular degree, generally the 98th in our thermometers. We therefore say the temperature of the hand is 98 degrees.

In effecting a measure of any kind, it is necessary to have a point from which to start and a point to which to go. The same is also necessary in making a scale. One of the essential qualities of a thermometer is to enable observers in all parts of the world to indicate the same temperature by the same degree. A common system of dividing the scale must therefore be agreed upon, that all thermometers may correspond.

If we dip a thermometer in melting ice or snow, the quicksilver sinks to a certain point, and to this point it will always come, no matter when or where the experiment is made. If we dip it in boiling water, it at once rises to another point. Philosophers in all countries have agreed, that these are the best fixed points to regulate the scale by, and accordingly they are now used in all thermometers. In the Fahrenheit thermometer, which is commonly employed, we mark the point at which the instrument stands, when dipped in melting snow, 32°, and that for boiling water, 212°, and divide the intervening space into 180 parts, each of which is a degree; and these degrees are carried up to the top and down to the bottom of the scale.

[As it is often necessary to reduce the scale of one of the various thermometers in general use to the corresponding degree of another instrument, we consider that the following remarks, extracted from "Brande's Dictionary of Science, Literature, and Art," will be useful to many of our readers:—

"For the sake of perspicuity, it is convenient to adapt the expressions to three distinct cases. Let F denote degrees of Fahrenheit's scale, C degrees of the Centigrade, and R degrees of Reaumur; then

Case 1.—For all temperatures above the freezing point, $F - 32 = \frac{9}{5}C = \frac{9}{4}R$.

Case 2.—For all temperatures between the freezing point and the zero of Fahrenheit's scale, $32 - F = -\frac{9}{5}C = -\frac{9}{4}R$.

Case 3.—For all temperatures below the zero of Fahrenheit, $-32 - F = -\frac{9}{5}C = -\frac{9}{4}R$."]

In different countries other divisions are used, adjusted, however, by the same fixed points. The Centigrade thermometer has, for the melting of ice, 0, and for the boiling of water, 100°, with the intervening space divided in 100 equal degrees. In Reaumur's thermometer, the lower point is marked 0, and the upper 80°.

The philosophical fact, upon which the construction of the thermometer reposes, is, that quicksilver expands by an increase of heat, and is contracted by a diminution of it; and further, that these expansions and contractions are in proportion to the changes of temperature.

But for particular purposes thermometers have been made of oil, of alcohol, and of a great many other liquid bodies, and give rise to the same general results. As a uniform law it may therefore be asserted that all liquids dilate as their temperature rises, and contract as it descends.

But heat determines the volume of gases as well as of liquids. If we take a tube, *a*, Fig. 297, with a bulb at its upper extremity, *b*, and having partly filled the tube with a column of water, coloured, to make its movements visible, the lower end dipping loosely into some of the same coloured water, contained in a bottle, *c;* on touching the bulb, *b*, the coloured liquid in the tube is pressed down by the dilation of the air, and on cooling the bulb the liquid rises, because the air contracts. And were the bulb filled with any other gaseous substance, such as oxygen, hydrogen, &c., still the same thing would take place. So gases, like liquids, expand as their temperature rises, and contract as it descends.

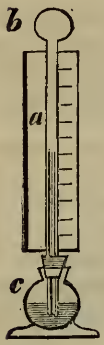

Fig. 297.

Such an instrument as Fig. 297, passes under the name of an air thermometer. Its indications are not altogether reliable, as may be proved by putting it under an air-pump receiver, when its column of liquid will instantly move as soon as the least change is made in the pressure of the air. It is affected, therefore, by changes of pressure as well as changes of temperature.

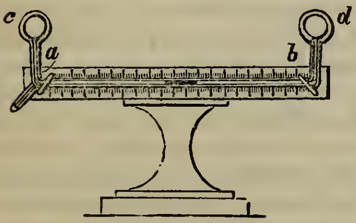

Fig. 298.

There is, however, a form of air thermometer which is free from this difficulty. It is the differential thermometer. This instrument consists of a tube, *a b*, Fig. 298, bent at right angles towards its ends, which terminate in two bulbs, *c d*. In the horizontal part of the tube is a little column of liquid marked by the black line, which serves as an index. If the bulb *c*, is touched by the hand, its air dilates and presses the index column over the scale; if *d* is touched the same thing takes place, but the column moves the opposite way; if both bulbs are touched at once, then the column, pressed equally in opposite directions, does not move at all. Of course, a similar reasoning applies to the cooling of the bulbs. The instrument is therefore called a differential thermometer, because it indicates the difference of temperature between its bulbs, but not absolute temperatures to which it is exposed.

In the same manner that we have thermometers, in which the changes of volume of liquids and gases are employed, to indicate changes of temperature, so, too, we have others in which solids are used. These generally consist of a strip of metal which is connected with an arrangement of levers or wheels, by which any variations in its length may be multiplied. The disturbing agencies, thus introduced by this necessary mechanism, interfere very much with the exactness of these instruments. And hitherto they have not been employed, except for special purposes, and can never supplant the mercurial thermometer.

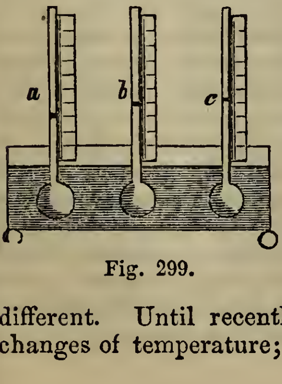

Fig. 299.

It being thus established that all substances, gases, liquids, and solids expand as their temperature rises, and contract as it falls, it may next be remarked that great differences are detected when different bodies of the same form are compared. There are scarcely two solid substances which, for the same elevation of temperature, expand alike. All do expand; but some more and some less. In the case of crystalline bodies, even the same substance expands differently in different directions. Thus a crystal of Iceland spar dilates less in the direction of its longer than it does in the direction of its shorter axis. The same holds good for liquids. If a number of thermometers, *a b c*, Fig. 299, of the same size be filled with different liquids, and all plunged in the same vessel of hot water, *f*, so as to be warmed alike, the expansion they exhibit will be very different. Until recently it was believed that all gases expand alike for the same changes of temperature; but it is now known that minute differences exist among them in this respect. For every degree of Fahrenheit's thermometer atmospheric air expands $\frac{1}{493}$ of its volume at 32°.

Gases, liquids, and solids compared together, for the same change of temperature, exhibit very different changes of volume; gases being the most dilatable, liquids next, and solids least of all. This, probably, arises from the fact that the cohesive force, which is the antagonist of heat, is most efficient in solids, less so in liquids, and still less in gases.

CHAPTER XLIX.

OF RADIANT HEAT.

Path of Radiant Heat—Velocity of Radiant Heat—Effects of Surface—Law of Reflection—Reflection by Spherical Mirrors—Theory of Exchanges of Heat—Diathermanous and Athermanous Bodies—Properties of Rock Salt—Imaginary Coloration.

Experience shows that whenever a hot body is freely exposed its temperature descends, until eventually it comes down to that of the surrounding bodies. There are two causes which tend to produce this result. They are radiation and conduction.

All bodies, whatever their temperature may be, radiate heat from their surfaces. It passes forth in straight lines, and may be reflected, refracted, and polarised like light.

The rate at which radiant heat moves is the same, in all probability, as the rate for light. It has been asserted that its velocity is only four-fifths that of light; but this seems not to rest upon any certain foundation.

As respects the rapidity or facility with which radiation takes place, much depends on the nature of the surface. The experiments of Leslie show that, at equal temperatures, such as are smooth are far less effective than such as are rough. This result he established by taking a cubical metallic vessel, *c*, filled with hot water, the four vertical sides being in different physical conditions—one being polished, a second slightly roughened, a third still more so, and the fourth roughened and blackened. Under these circumstances, the rays of heat escaping from each surface as it was turned in succession toward a metallic reflector, M, raised a thermometer, *d*, placed in the focus, to very different degrees, the polished one producing the least effect.

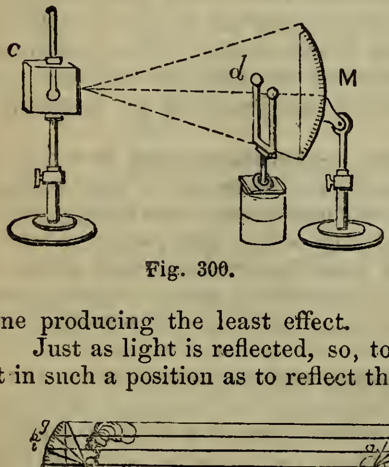

Fig. 300.

Just as light is reflected, so, too, is heat. If we take a plate of bright tin, and hold it in such a position as to reflect the light of a clear fire into the face, as soon as we see the light we also feel the impression of the heat. The law for the one is also the law for the other—" the angle of reflection is equal to the angle of incidence"—and consequently mirrors with curved surfaces act precisely in one case as they do in the other. We have already shown, Chapter XXXVI., how rays diverging from the focus of a mirror are reflected parallel, and how parallel rays falling on a mirror are converged. And it is upon that principle that we account for the following striking experiment. In the focus of a concave metallic mirror let there be placed a red-hot ball, *a*, Fig. 301; the rays of heat diverging from it in right lines, *a c*, *a d*, *a e*, *a f* will be reflected parallel in

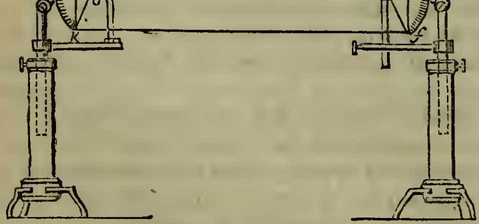

Fig. 301.

the lines *c g*, *d h*, *e i*, *f k*, and, striking upon the opposite mirror, will all converge to *b*, in its focus. If, therefore, at this point any small combustible body, as a piece of phosphorus, be placed, it will instantly take fire, though a distance of twenty or fifty feet may intervene between the mirrors. Or, if the bulb of an air thermometer be used instead of the phosphorus, it will give at once the indication of a rapid elevation of temperature.

But this is not all; for if, still retaining the thermometer in its place, we remove away the red-hot ball and replace it by a mass of ice, the thermometer instantly indicates a descent of temperature—the production of cold. At one time it was supposed that this was due to cold rays which escaped from the ice, after the same manner as rays of heat; but it is now admitted that the effect arises from the circumstance that the thermometer bulb, being warmer than the ice, radiates its heat to the ice, the temperature of which ascends precisely in the same manner as that in the former experiment; the red-hot ball being the warmer body, radiated its heat to the thermometer.

In fact these experiments are nothing more than illustrations of a theory which passes under the name of "The Theory of the Exchanges of Heat." This assumes that all bodies are at all times radiating heat to one another; but the speed with which they do this depends upon their temperature, a hot body giving out heat much faster than one the temperature of which is lower. Thus, if we have a red-hot ball and a thermometer bulb in presence of one another, the ball, by reason of its high temperature, will give more heat to the bulb than it receives in return; its temperature will therefore descend, while that of the bulb rises. But if the same bulb be placed in presence of a mass of ice, the ice will receive more heat than it gives, because it is the colder body of the two and the temperature of the thermometer therefore declines.

All bodies are at all times radiating heat, their power of radiation depending on their temperature, increasing as it increases, and diminishing as it diminishes.

As is the case with light, so, too, with heat; there are substances which transmit its rays with readiness, and others which are opaque. We therefore speak of diathermanous bodies which are analogous to the transparent, and athermanous which are like the opaque. Among the former a vacuum and most gaseous bodies may be numbered; but it is remarkable that substances which are perfectly transparent to light are not necessarily so to heat. Glass, which transmits with but little loss much of the light which falls on it, obstructs much of the heat; and, conversely, smoky quartz and brown mica, which are almost opaque to light, transmit heat readily. But of all solid substances, that which is most transparent to heat, or most diathermanous, is rock salt; it has therefore been designated as the glass of radiant heat. If a prism be cut from this substance, and a beam of radiant heat allowed to fall upon it, it undergoes refraction and dispersion precisely as we have already described as occurring under similar circumstances with a glass prism for light in Chapter XXXIX. And if convex lenses be made of rock-salt they converge the rays of heat to foci, at which the elevation of temperature may be detected by the thermometer. Heat, therefore, can be refracted and dispersed as easily as it can be reflected.

If we take a convex lens of glass and one of rock-salt, and cause them to form the image of a burning candle in their foci, it will be found on examination that the image through the rock-salt is hot, but that through the glass can scarcely affect a delicate thermometer. This experiment sets in a clear light the difference in the relations between glass and salt, the former permitting the light to pass, but not the heat, the latter transmitting both together.

When light is dispersed by a prism the splendid phenomenon of the spectrum is seen. But in the case of heat our organs of sight are constituted so that we cannot discover its presence, and therefore fail to see the corresponding result. But it is now established beyond all doubt, that in the same manner that there are modifications of light giving rise to the various coloured rays, so, too, there are corresponding qualities of radiant heat. Moreover, it has been fully proved that, as stained glass and coloured solutions exert an effect on white light, absorbing some rays and letting others pass, the same takes place also for heat. In the case we have already considered—of the imperfect diathermancy of glass—the true cause of the phenomenon is the colouration which the glass possesses as respects the rays of heat, and inasmuch as a substance may be perfectly transparent to one of these agents and not so to the other, so, also, a body may stop or absorb a given ray for the one, and a totally different one for the other. Glass allows all the rays of light to pass almost equally well, but it obstructs almost completely the blue rays of heat. The colouration of bodies, which has already been described as arising from absorption, may, therefore, be wholly different in the two cases; and as our organs do not permit us to see what it is in the case of heat, and we have to rely on indirect evidence, we speak of the imaginary or ideal colouration of bodies.

If heat, like light (as there are reasons for believing), arises in vibratory movements which are propagated through the ether, all the various phenomena here described can be readily accounted for. The undulations of heat must be reflected, refracted, inflected, undergo interference, polarisation, &c., as do the undulations of light, the mechanism being the same in both cases.

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OUR NATIVE LANGUAGE AND AUTHORS.—No. I.

> "Where do the words of Greece and Rome excel,
> That England may not please the ear as well?
> What mighty magic's in the place or air,
> That all perfection needs must centre there?"—Churchill.

Most of our readers, we hope, will be ready to allow that our language is as rich, and our authors as highly gifted, as any on the face of the earth; but there are not many who try to trace the stream of literature to its source, to cast their eyes backwards to the days of no books and a simple language, and to mark the progress by which we have arrived at our present abundance of words and volumes: yet the review is neither uninstructive nor uninteresting, and, with permission, we will enter on a slight retrospect.

We have heard the question gravely discussed, what kind of words were first used? one party contending for nouns, because names must first have been necessary; another arguing in favour of verbs, because so many names seem derived from an action, which must be indicated by a verb; and a third upholding adjectives, because a quality rather than an action is generally expressed in a name.

With such abstract questions we have no present concern (only observing, in passing, that names are the first words of which we have any historical record); nor shall we attempt to analyse the language of the famous Welsh pedigree, in which, it is said, at a considerable distance from the beginning, occurs this marginal note:—"About this time was the creation of the world." Yet we do mean to ascend high in the realms of antiquity, when men were literally men of few words, because they had but a scanty vocabulary; when emblem stood in the place of description—as, for instance, a hero was called an eagle, because no term existed for the aquiline qualities of strength, quickness, and power.

In those days, when the silver Thames flowed through the "forest primeval," its ripple unbroken by oar or keel—when the "Severn swift" rolled from Plinlimmon to the main, its murmur unheard by mortal ear—when the Trent spread its thirsty arms along the "indented meads," no human form or face reflected in the glassy waters,—there came to the shores of uninhabited England a band of warriors. Where they landed, how they journeyed, or whence they came, we have asked in vain of Fame and Time. Oblivion answers, "the tale is *mine*." Neither has certain record remained from which of Noah's sons they were descended; they might have been of the race of Shem, whose posterity is described as wandering eastwards; and their gradual disappearance before another race may be a fulfilment of the prophecy, that Japhet should dwell in the tents of Shem. Nor is it known why they wandered so far; it might have been in search of a blest island of the west, the existence of which seems to have been a prevalent belief from the earliest ages (probably from a tradition, that the Eden, whence the universal Father was driven, lay in that direction). All this is conjecture; but it seems certain that they came from the northern parts of the Peninsula of India, that they overran great part of Europe, and that they were called *Celts*, or *Kelts*.

They overspread the country, and gave names to the rocks and hills: these records remain to this day. Wherever we find the terminating syllable *'don*, we may know that it was the Celtic *dun* (meaning, in their language, a fortified rock); wherever we observe *Car* or *Caer* forming part of a name, we may believe it to be the Celtic *Caer* (meaning a rock or stone). The rocks and stones bear witness to them; the rocks and hills were their refuge when driven before their foes,—there, in the remote parts of Wales and Scotland, their race and language still exist; but in England, all other trace than the slight one above mentioned is lost. The few words of their tongue, which are common to our own, have been adopted at subsequent periods, in the same way as it is said some English manufactures have been exported to receive a foreign mark, and to be brought back in order to allure purchasers who despise the works of their own country.

The Celts inhabiting Britain enter on the page of history for the first time, when Julius Cæsar brought his victorious legions to our shores. The circumstances attending the subjection of the Celts, or their gradual retreat from fastness to fastness, are well known; as also the events of the four hundred years during which the Roman power reigned supreme, and of the following years, when these conquerors disappeared by degrees as the Saxons, another northern tribe, advanced. As vestiges of their sway, the Romans left many a fort (indicated wherever the word *Chester* occurs); many a wall which still defies the ravages of time; a road through the whole length and breadth of the land; many villas and towns which gradually disappeared from the *surface* of the soil, to be again disinterred in after years by the track of the plough or the research of the antiquary.

As the Saxons overspread the country, their appellations succeeded, or combined with, the names formerly given to places. *Borgh*, or *burgh*, is one of their distinctive terminations. Their language became universally spoken, forming the great foundation of our own. They came by water from afar, and brought us the word *seaman*—a name dear to every true Englishman. The terms by which they distinguished common objects and actions, exist, little changed, to this day: man, woman (or *wifman*), wife, sun, moon; to live, eat, run, swim, fly, shine; king, queen, earl, house, home; red, green, yellow; horse and neigh, sheep and bleat, hound and bark: for almost every word which represents a simple idea or action, we are indebted to our Saxon ancestors. Their alphabet contained twenty-five letters: we have equivalents for all their letters, except a character for the *th*. We have, in addition, the *j*, and three letters to express the sounds of *u*, *v*, and *w*; whereas the Saxons had but two.

There is a still more ancient language than the Saxon, supposed to be the original of all the tongues of northern Europe, except the Sclavonic; this language is called by Dr. Johnson the Gothic, and of it there is one monument remaining—an ancient copy of the Gospels, somewhat mutilated, called the Silver Book, from the silver with which the characters were adorned. It was preserved at Upsal, in Sweden; but a copy has been published in England. In the Lord's Prayer there are several words which bear evident resemblance to our own; as, for example, *namo* for name, *wilja theins*, for thy will (here it may be observed that the *j* occurs, although not given in the Saxon alphabet), *himina* for heaven, *airthaî*, earth, *himmadaga*, this day, *briggaisuns*, for lead, or bring us, *lausseiuns*, for deliver, or loose us.

Of the Anglo-Saxon literature, many specimens are extant; the earliest of which is a hymn composed by Cædmon, a monk, which possesses considerable beauty. The Anglo-Saxon laws, before the reign of Athelstane, and the works of King Alfred, are considered to be those which exhibit the language in its greatest purity. The gradually-increasing intercourse with Rome caused the introduction of many words of mediæval Latin; and the conquest of the land by the Danes must have had its effect, though not a considerable one, on the language. But when the Normans came like a flood, overwhelming the Saxon hosts, destroying their strongholds, forbidding the exercise of their customs, refusing to understand their words, it seemed inevitable that a new speech should be introduced.

It is very remarkable, that, although the Norman was the language of the court, the camp, and of law, for near two hundred years, the Saxon material still remained. The conquerors who congregated in towns might persist in buying their meat as beef, veal, mutton, and pork (all these words are of Norman derivation); the Saxons who kept their herds and flocks still retained the old appellations for their animals, of oxen, calves, sheep, and swine. At length the effects of this foreign invasion gradually subsided, like those of an inundation (as Campbell beautifully expresses it), which, although it seems at first to produce only destruction, at length retires, leaving behind the elements of fresh fertility.

It is not intended, however, to maintain that there had been no introduction of Norman words before the Conquest. The historical student will remember that it was so much the custom for the nobles of England to send their sons to the French court for the acquirement of accomplishments, that a proverb satirizing the habit was prevalent—" Jacke would be a gentilman if he coud but speke Frenshe." Yet there was little in common between the tongues; for it is related, that in a progress through Pembrokeshire, when Henry II. was addressed by some of his subjects as "goode olde Kynge," he was obliged to inquire of his courtiers the signification of the words.

During the period of war and bloodshed which followed the Conquest, learning was in some measure preserved in the monasteries. The Saxon "Chronicle," that venerable monument of English history, was partly, if not entirely, written. It is evidently the work of many writers, and exhibits great diversities of style. It is intended to give an account of English annals, from. A.D. 1; and though the earlier portion, as might be expected, is filled with trivial and improbable fables, the importance of the work, as an historical document, can scarcely be over estimated. It increases as it approaches the conclusion (in the year 1150); the descriptions of the more recent events, and the portraits of contemporary personages, bearing, in many cases, evident marks of being the productions of men who were eye-witnesses to the circumstances, of which they give the details.

One of the most well-known works of this period is the composition of "Layamon," who tells us of himself that his father's name was Leovenath (by which we may be sure of his Saxon extraction); that he himself was a priest at Erneley-on-Severn, in Worcestershire; there he "*booke radde*," and there he conceived the thought of writing annals of England, confining himself, with more moderation than some antiquaries, to the period *after* the flood. The difficulty of obtaining books being such as we of this day can scarcely imagine, he was at the pains of making a pilgrimage far and wide in search of materials. Having succeeded in procuring the English book made by St. Bede, the Latin one of St. Albin and St. Austin, and the "Brut d'Angleterre" (or Brutus of England), of Wace, he describes that he laid these books before him, turned over their leaves, and *thrummed* the three books to one. It seems that it is to Wace's Romance of Brutus that he is chiefly indebted, and which forms the chief material of his "Chronicle."

Having followed the example of the good priest of Erneley, in *thrumming* various books to one for the edification of our readers to this length, we will not pause to enter into minute detail of the progression of our language, though we may refer to some particulars as occasion requires; but we will pass at once to the "Life of Chaucer," the great father of our poetry and language.

◆

EDUCATION IN THE SIXTEENTH CENTURY.

Both the old monastic schools and the new foundations at the two Universities of Oxford and Cambridge being considered, to a certain extent, charitable institutions, were principally attended by the children of persons in humble, or, at least, in common life. Among the nobility the general custom, for boys as well as girls, was to educate them at home, or to have private tutors to superintend them. A notion of the extent and mode of training, which youths of rank underwent in their earliest years, may be obtained from some letters which have been recently published, addressed to Henry VIII.'s minister, Cromwell, by the tutor of his son Gregory.

This youth, whose capacity is described as rather solid than quick, divided his time under different masters among various studies and exercises, of which English, French, writing, playing at weapons, casting of accounts, and "pastimes of instruments," are particularly enumerated. One master is stated to be in the habit of "daily hearing him read somewhat in the English tongue, and advertising him of the natural and true kind of pronunciation thereof, expounding also and declaring the etymology and native signification of such words as we have borrowed of the Latins or Frenchmen, not even so commonly used in our quotidian speech." According to a common practice, two other youths, probably of inferior station, appear to have been educated along with young Cromwell; and between him and them, the account continues, "there is a perpetual contention, strife, and conflict, and in manner of an honest envy, who shall do best, not only in the French tongue (wherein Mr. Vallance, after a wondrously compendious, facile, prompt, and ready way, not without painful diligence and laborious industry, doth instruct them); but also in writing, playing at weapons, and all other their exercises." In the end a confident hope is expressed that, "whereas the last summer was spent in the service of the wild Goddess Diana," the present shall be consecrated to Apollo and the Muses, to the no small profit of the young man, as well as to his father's good contentation and pleasure.

This letter is dated in April; another, written in September (apparently of the same year), by which time the boy had begun the study of some new branches, especially Latin and instrumental music, enters into some more minute and curious details of how he spent his time.

"First," says his tutor, "after he hath heard mass, he taketh a lecture of a dialogue of Erasmus's colloquium, called "Pietas Puerilis," wherein is described a very picture of one that should be virtuously brought up; and, for cause it is so necessary for him, I do not only cause him to read it over, but also to practise the precepts of the same; and I have also translated it into English, so that he may confer therein both together, whereof, as learned men affirm, cometh no small profect." The letter goes on:—"After that he exerciseth his hand in writing one or two hours, and readeth upon 'Fabian's Chronicles' as long; the residue of the day he doth spend upon the lute and virginal."

Lastly, the tutor gives an account of the out-door exercises followed by his pupil; intellectual conversation, however, being by no means disregarded even in some of these:—"When he rideth, as he doth very oft, I tell him by the way," he says, "some history of the Romans or the Greeks, which I cause him to rehearse again in a tale. For his recreation he useth to hawk and hunt, and shoot in his long bow, which frameth and succeedeth so well with him that he seemeth thereunto given by nature."

This training, as far as it is detailed, appears to have been judiciously contrived for laying the foundation of a good and solid education, both of the mental and physical faculties.

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PRESENT STATE OF NATIONAL EDUCATION,

AS REPORTED BY THE GOVERNMENT INSPECTORS OF SCHOOLS.

Her Majesty's Inspectors of Schools have lately issued their reports for 1852, which, as regards the statistical matters collected, and the opinions of the inspectors on the present state of elementary education, possess many features of the deepest interest to the scholastic profession, and to the public at large. It would, however, have been a great convenience if a table of contents, or a general index, had been prefixed to each report; as at present there are neither digests nor summaries to assist the reader. Moreover, as the reports run from October to October, and the minutes, which constitute them, have not been long issued, many of the particulars there mentioned are nearly two years old. This is rather an objectionable feature; for in many cases unfavourable reports, having reference to the state of the school two years ago, now come before the undiscerning public as representing its present condition, and are so quoted very much to the disadvantage of the unfortunate schoolmaster, who may have laboured and very successfully since that time to improve the school, and may have obtained from the inspector, at a subsequent visit, a highly favourable report, which, however, will not be made public till it appears in the next volume of Minutes. The evil is that a second examination has taken place before the report on the first has made its appearance. People are sure to apply the report to the last examination, and to take from it general impressions about the school and the schoolmaster, which no subsequent explanation on his part, as to dates, may entirely remove from their minds.

Of the STATE OF EDUCATION in this country, and of the various methods of instruction at present employed in our schools, there is much useful and often important information. The reports do not embrace the whole of the schools in their districts, but only a portion, and those, as a general rule, the best managed and most efficient.

Most of the English inspectors report favourably of the progress of the schools under their inspection during the course of last year. Thus the report from the Midland counties, embracing Oxford, Warwick, Worcester, Gloucester, Hereford, &c., are all of a gratifying character. Mr. Bellairs, the inspector for those districts, says that "the schools, in which certificated teachers and apprentices are employed, are, for the most part, in a very satisfactory condition, presenting a marked contrast to those which have not availed themselves of the aid afforded by the Minutes of 1846. The large towns, where public opinion and religious rivalship extensively prevail, are receiving large annual grants under the regulation of these Minutes. This is not so commonly the case where property is less equally distributed, where the population is small or scattered, where public opinion is ill informed or weak, and where poverty prevails. School endowments have also a tendency to check the operations of these Minutes, not so much from the provision of enlightened education by means of these funds, as by the encouragement of a "laissez faire" spirit, and by the difficulty they create of removing inefficient teachers. The supply of efficient teachers, which is now for the first time approximating to the demand, will test the disposition of those managers who have not yet received aid, as to their desire to improve the condition of their schools."

Of the western districts of England, comprehending Dorset, Somerset, Devon, and Cornwall, Mr. Tinlis thus writes:—"In looking back to the progress of education to the different schools during the last year, I consider that in the better class there has been a steady continuation in their advanced position, rather than any especial onward movement in the attainments of the children; whilst in the rest there has been a fuller realization of their imperfect state, and a general desire manifested to ascertain the readiest and most sure means for self-improvement. This has been the case especially in the rural districts, as far as I have been able to judge."

The state of education in the great manufacturing and mining districts of the north-western parts of England must at all times be of vital importance to the well-being of the community. In these districts, it must be admitted, education has not hitherto kept pace with the industry, wealth, and enterprise of the ever-increasing population. Yet, from the favourable report given by Mr. Morris, we may now venture to augur a happier state of things, and to hope that the barbarism of the past is rapidly giving way to the ameliorating influences of education and the liberal arts.

> "Didicisse fideliter artes
> Emollit mores, nec sinit esse feros."

"The year which is now closing," says the Government inspector, "has been one of marked progress in the three counties of Chester, Stafford, and Salop. Education has clearly advanced, both in public estimation and in its practical development over the country. Among the principal heads of this progress may be mentioned:—1. The satisfactory completion of forty-six apprenticeships. 2. A general movement among the schoolmasters of my district, having for its object their own improvement by means of association for mutual instruction. 3. Connected with this, and in a great measure resulting from it, a large increase of the number of certificated teachers. 4. The extension of industrial training in connection with *boys'* schools. 5. The general impulse given to the study of drawing as a branch of elementary education, by the department of practical art, under the Board of Trade. 6. The formation of two important associations for the advancement of education by means of prize schemes, in South and North Staffordshire respectively."

Another of her Majesty's inspectors (Mr. Stewart), thus speaks of the extreme northern counties of England:—"In my report for the year 1851, I ventured to express my belief that a considerable improvement, in the educational resources of the four northern counties, would take place in the course of the year which has just closed. The expectations have not been disappointed. There has been a steady increase in the number of trained teachers holding *certificates of merit* employed in the district; the number of schools aided by *pupil-teachers* is larger than it was; the efficiency of the schools is improved, and a greater number of institutions has been brought under *inspection.*"

According to a very sensible report, furnished by Mr. Jones, we find that the spirit of educational progress has even penetrated into the mountain districts of the principality of Wales, and thus the ancient Celtic population of the British empire is at length destined to enter into honourable rivalry with its Saxon brethren in the great march of human civilization. "The schools of Wales and Monmouthshire," says the inspector, "have effected as much as can be reasonably required of them, during the period in which they have had the advantage of being under the supervision of the Committee of Council on Education. The methods of instruction adopted, the ability and character of the teachers, together with the good will and intelligence of the people at large, in this district, have raised education to such a point that, I think, it will not readily retrograde, if only present exertions be continued for its support. There is, however, abundant reason to hope for gradual and solid improvements as time rolls on; and, in my opinion, what may be called the 'Education Question' is secured for the principality. There is no cause to be otherwise than satisfied with the general condition, progress, and prospects of schools in Wales and Monmouthshire."

Scotland has always distinguished herself for the spirit which she has exhibited in the general diffusion of elementary education. Hence we find that few of her sons, however humble their station, are entirely uneducated. But we find that the Government inspectors do not express themselves in such decidedly favourable terms as we should have expected. Their commendations are, at all events, of an equivocal character. Thus Dr. Cumming says:—"With regard to the schools generally which I have visited during the past year, I think that they are in an improved condition, as compared with the year preceding; and if, in the observations which I have still to make, I should seem to dwell on their defects," &c. Dr. Woodford also speaks to the same purpose:—"I should state that I have been more particular in calling attention to points that seemed to be susceptible of improvement, than to others that might be enumerated as satisfactory, or in terms of higher commendation."

Taking a general review, however, of the state of education for the last few years, whether in England, Wales, or Scotland, we believe we have the fullest reason for congratulation. Something like progress has evidently been made in the midst of all the semi-barbarous sterility of past ages; and this, we consider, has been greatly promoted by the operations of the Government Minutes of 1846. It is no longer a mere experiment; the system thereby introduced now forms an integral part of our educational organization, and must assuredly constitute the principal feature of any general scheme of national education which the legislature of the country may think proper to adopt, and which the community at large may require.

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LESSONS IN NATIONAL HISTORY.

No. VIII.

> "Contention, like a horse
> Full of high feeding, madly hath broke loose,
> And bears down all before him."—SHAKSPERE.

CHINA AND ITS REVOLUTIONS.

WE have already brought down the history of this ancient empire from the remotest periods of her authenticated annals to the reign of the present emperor, KIEN-FUNG; and have laid before the historical student all the most interesting epochs, and great revolutionary changes, which her wonderful annals present to the mind of the historian. It now only remains for us to give, in conclusion, a general view of the present aspect, political and social, of this hitherto unexplored region of the East, and especially of the origin and history of the formidable insurrection which threatens to annihilate the existing dynasty, and revolutionize the ancient religion of the "flowery land."

It may be here necessary to explain, that in China there are two distinct races—the Mantchou Tartars and the native Chinese. The former are the dominant cast, who subdued the Chinese above two centuries ago, and overthrew the ancient dynasty of the Mings—the details of which were given in p. 209. The native Chinese, however, are far their superiors in intelligence as well as in numbers, and have long groaned under the despotism of their ignorant taskmasters, whose religion was as little palatable to them as their laws. The Imperial Government went on blindly and tyrannically, as if it were to proceed in the same course for ever. The wretched people continued to be plundered and punished as though they had reconciled themselves to robbery and cruelty, as a state of things in their favoured land that was never to alter. They, however, contrived to communicate with "the Outside Barbarian," and more than one influential native gladly accepted both his schooling and his religion.

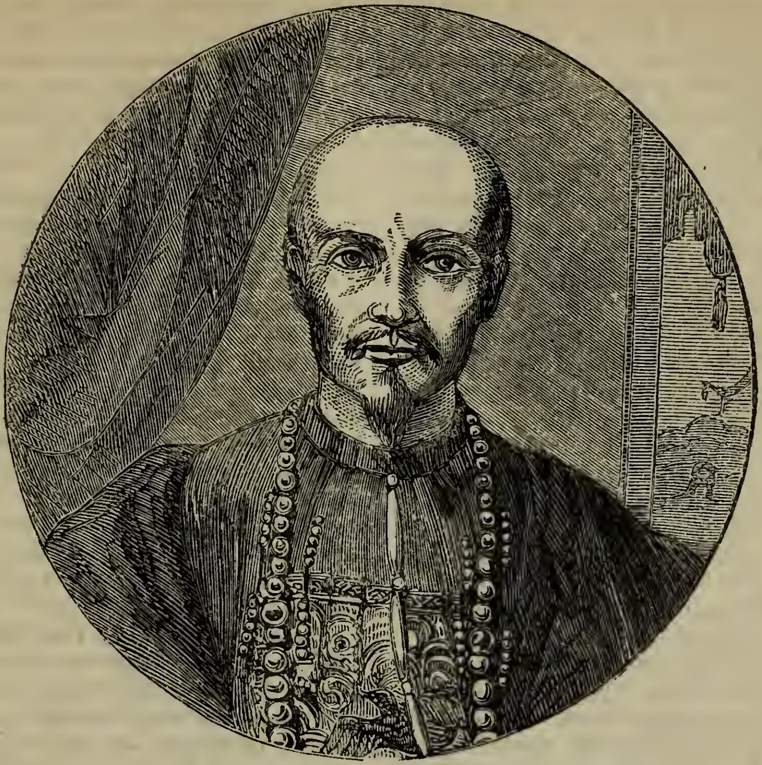
About three years ago, a rumour became current that a rebellion had commenced in China; but as this vast territory contained districts in which the Tartar tax-gatherers often experienced considerable trouble in collecting the proper contribution to the Imperial treasury, it was thought to be nothing more than an anti-tax disturbance, which the Imperial troops would be sure to put down. But it appears that these troops were put down instead of the disturbance; the disaffection spread rapidly; whole provinces began to swarm with rebels; and the Tartar generals, sent one after another to cut them to pieces, were signally defeated. The disturbance now assumed the character of a real insurrection. On swept the rebellious tide; beating armies, assaulting cities, and overrunning the finest provinces in the empire; till it was evident that the Imperial Government was in danger, and every attempt was made by the mandarins and the royal troops to arrest the onward march of these audacious rebels; but the former were everywhere defeated, and the latter cordially received by the native population.

The district where these daring insurgents first began their victorious career is Quang-si, or Kouang-si,—a wild and mountainous region, situated at the south-western extremity of the Chinese empire. The principal inhabitants are the Miao-tzes, an indomitable race of mountain warriors, who have never been subdued by the Tartar troops. Some notices of these warlike tribes, and of their formidable contests with the Imperial forces, have already been given in our last number, pp. 231, 232.

The insurgents of the province of Quang-si, and of the two Kouangs, did not fail to avail themselves of the terror inspired by the very name of Miao-tze. They immediately proclaimed an alliance with these redoubtable warriors, and induced them to take up arms for the recovery of their lost privileges, and to effect the overthrow, if possible, of the Tartar despots.

The progress of the rebels was at first slow, and their operations insignificant. In August 1850, however, the Pekin journals first announced the existence of a predatory warfare in Quang-si; and shortly afterwards the rebels possessed themselves of one or two important towns on the frontiers of Kouang-tong, of which Canton is the capital. The Viceroy of the two Kouangs, named Siu, despatched troops against the insurgents; but his forces were utterly annihilated. The Viceroy, in a state of consternation, hurried off to Pekin, to report the alarming state of affairs, and the rebels immediately entered Kouang-tong. From this time they never attempted any expedition, unless certain of victory.

The principal leader of this formidable insurrection is Tschu-kin-Tao, or Hung-saw-Chuen, although by his followers he is called Tien-teh—a designation which signifies "*Heavenly Virtue.*" He claims to be a descendant of Chu-yuen-Chang—a man sprung from the ranks of the people, who, in the year 1352, headed a revolt, and after a struggle of sixteen years, drove out, in 1368, the Mongolian dynasty, which then oppressed the native Chinese, and



TIEN-TEH, CHIEF OF THE CHINESE INSURGENTS.

founded the dynasty of Ming (see p. 168). This great family gave the Chinese no less than sixteen Emperors, most of whom were men of ability and worth. The Ming dynasty remained at the head of the State until the year 1644; when it was, in its turn, expelled by the Mantchoo dynasty of Tsing, of which the present Emperor is the representative (see p. 209). Under Tien-teh, there are four generals, called, agreeably to their local positions, commanders of the East, West, North, and South.

According to the various accounts we have received, Tien-teh is represented as living in close retirement, only showing himself occasionally to his immediate followers, and then only to issue his commands. His expression, though far from prepossessing, denotes mildness, combined with great decision, and a degree of firmness verging upon obstinacy. His complexion is sallow, with a decided saffron tinge. In stature he is above the middle height; and, though of about the same age, is taller and less strongly built than Hien-fung, the Emperor, whose deposition he seems resolved, at all hazards, to effect. He travels in a palanquin inclosed with curtains of amber-coloured silk, borne on the shoulders of sixteen officers of distinction; his preceptor, or privy councillor, or adviser, carried by eight coolies, follows immediately in his wake; and then comes Tien-teh's 30 devoted wives, for all of whom he is said to possess the sincerest affection. They are arrayed in costly apparel, and follow each other in single file in commodious arm-chairs. A long retinue of servants, and a vast array of soldiers, bring up the rear of the procession.

One of the missionaries of China, the Rev. J. Roberts, has communicated some interesting particulars of the early life of this remarkable chieftain:—"*Hung-saw-Chuen* (says he) studied books from his early youth, was intelligent beyond comparison, and having read all kind of books, went to the examination at fifteen or sixteen years of age. At one of the examinations in Canton, he met an extraordinary-looking man, with large sleeves and long-beard, who gave him a book entitled, 'Huen sci Leong Quen,' '*good words exhorting the age*.' In this book it was taught that men ought truly to believe in God, on Jesus, obey the Ten Commandments, and not worship devils. Afterwards, when sick, he had a vision, in which he received instructions corresponding with those doctrines taught in the book, and therefore he immediately commenced speaking and acting according to the instructions of the book received. Then he travelled in Kwangsi province, and made several books, exhorting men to forsake the false and turn to the true. Some time after he received the religious book referred to above, he went to the chapel in Canton, where he continued for several months memorizing the Scriptures, and studying the doctrines. After which he went to Kwangsi, and published them."

This insurgent chief has now assumed all the prerogatives and distinctions of royalty, as a descendant of the illustrious family of the Mings. He issues manifestoes as generalissimo of the army of the restored dynasty; and the patriot forces have, by degrees, extended their conquests through the provinces of the two Quang-sis, until they have obtained possession of Nankin, Chin-kiang-foo, Yang-chow, and Amoy; and they are now preparing to attack the great northern capital of China.

But the most interesting feature of these insurrectionary proceedings is the established fact that the rebels, or patriots, as they may now be called, are essentially PROTESTANT CHRISTIANS! From letters written on board the "Hermes," which carried Sir George Bonham on his visit to the Chinese insurgents at Nankin, we have obtained the fullest particulars of the religious faith and character of the rebels. Their notions are rather fanatical. Their chief, or king (say they), was taken up into heaven, and there invested with power to reign. In matters of temporal concern (they pretend) their chief frequently receives revelations from God; but he disclaims the titles of *Supreme, High,* and *Father,* because these belong to God alone. The Bible is their rule of faith; but they have no priests or religious teachers, as they hold that all believers are sufficient for such purposes. They declare themselves, and the Imperialists describe them, as worshippers of Jesus. They circulate tracts, which are drawn directly from the Scriptures. They adopt the Ten Commandments, with slight modifications, and destroy every vestige of idol worship with which they meet.

The *North China Herald* has also favoured us with the following remarks, as confirmatory of the preceding:—

"The insurgents are Christians of the Protestant form of worship, and anti-idolaters of the strictest order. They acknowledge but One God, the Heavenly Father, the Allwise, Allpowerful, and Omnipresent Creator of the World; with Him, Jesus Christ, as the Saviour of mankind; and also the Holy Spirit, as the last of the Three Persons of the Trinity. Their chief on earth is a person known as 'Tae-ping-wang, the Prince of Peace,' to whom a kind of divine origin and mission is ascribed."

There is little doubt that the Christian religion, which forms the most extraordinary feature of the Chinese insurrection, first found its way into the mountainous district of Quang-si, where the rebellion originated, through the medium of the various missionaries, who each pursued their labours in the kingdom of Annam, a south-eastern district, bordering on these Chinese provinces, where the sacred truths of the Christian religion were first heard in 1627, and responded to by 200,000 conversions. Thus, for the two last centuries has the religion of Jesus been gradually working its way into the heart of the Chinese empire, in defiance of imperial edicts, and the relentless persecutions of the local authorities.

It is impossible to doubt but that the rigorous despotism and idolatrous superstition, which for centuries have cramped and insulated an empire computed to contain a third of the human race, are at length destined to come to an end. The days of the Tartar dynasty are fast drawing to a close. The Imperial troops are either apathetic or disorganized; and the reigning monarch appears deficient in even the ordinary courage of despair, which other sovereigns have sometimes found in circumstances equally perilous. It is, indeed, incompatible with the precepts and instruction of history, that even so ancient and so vast a kingdom as China should much longer remain in the bondage of its ancient prejudices. Isolated notions only can perpetuate ignorance, transmit superstition, or make permanent the workings of its own evil genius. The tendency of the age is against isolation. While many run to and fro knowledge cannot but be increased. The obscure nations of the earth are sought out—they see their betters, mingle with them, imitate them, learn their arts, and share their improvements. To this genius of our epoch, China, like the rest of the world, must yield, and is yielding. The present movement, by sure degrees, will penetrate the heart of that great country, and leaven the whole mass of its population. By the force of circumstances alone, China must be revolutionized; and this revolution, like the nation itself, will be unique. It will not be like the risings of early Rome, nor the demonstration of the Barons at Runnymede, nor the rebellion of the Puritans, nor the revolution of 1688, nor the war of American independence, nor the revolution of France, nor the seditions of Ireland. Out of its own heart will come forth the bursting energies of the nation, and upon its own defects and deformities it will make war, until all its ancient prejudices and national pride,—its wretched bigotry and ridiculous exclusiveness,—will at length be broken like a rope of sand, and disappear before the advancing spirit of Christian civilisation.

"At the present moment," says the editor of "Christianity in China,"* "a religious movement is at work, which cannot fail, eventually, to revolutionize the whole empire. The insurgents, who have suddenly sprung up, as it were, from the very 'bowels of the land,' have adopted the ancient banner of Christian victory—'EN TOΥΤΩ NIKA'—and, under its inspiring auspices, they cannot fail to be ultimately triumphant. The glories of the ancient dynasties of Hia, of Shang, and of Chau; of Han, of Chin, and of Tang, must shrink into insignificance, when compared with the momentous consequences which may flow from the extraordinary contest now carrying on between the regal descendants of the Mings and the Mantchous.

P. A. Nuttall.

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* Published by Orr and Co., price 1s.

THE TRAINING SCHOOLS.

QUEEN'S SCHOLARS, CERTIFICATED TEACHERS, &c.

The Committee of Privy Council on Education have issued an official document, dated August 20, 1853, which is of considerable importance to the scholastic profession. It is entitled a "Supplementary Minute," and is a kind of addendum to the Minute of 1846, which related to the support of Normal Schools, and the appointment of Queen's Scholarships, and issuing certificates of merit. In this supplementary minute their Lordships state that they had taken into consideration certain complaints alleged against the present system, to the effect that certificates were granted without sufficient guarantee for practical ability in teaching; that such ability was not sufficiently rewarded; that the training schools were inadequately maintained—not fully occupied, nor always with the class of students best adapted for training; that a large portion of the pupil teachers who had completed their term of service did not enter the training schools, &c. Their Lordships therefore adopted a series of resolutions, by which they have determined to renounce the limitation at present imposed on the admission of Queen's Scholars; the number of students capable of being accommodated in training schools under inspection being at present limited to 1,143 males, and 788 females.

Their Lordships then propose to renew the Queen's Scholarships for a second year to all Queen's scholars of one year's standing who pass a satisfactory examination at the end of it. But what is of still greater importance, their Lordships, in order to promote in training schools the study of the subjects proper to elementary instruction, will grant augmentations of salary of £100 annually to such resident lecturers as shall receive, independently of those augmentations, salaries of not less than £150 annually, provided he affords sufficient evidence of his capabilities in one or two of the branches of knowledge required, viz., History, English Literature, Geography, Physical Science, and applied Mathematics.

Various important regulations are enumerated in this supplementary minute, which, if carried into operation, cannot fail to be of great service in promoting the general cause of education, and, at the same time, giving a status and a certain degree of respectability to the members of the scholastic profession. For instance, their Lordships will allow, without further examination, a Queen's Scholarship of £25 to all assistants who shall for three years have acquitted themselves satisfactorily, pursuant to the Minute of 23rd July, 1852; and in schools where the average attendance exceeds 100, their Lordships will apply the above Minute, without requiring that an assistant shall be taken to be in lieu of two pupil teachers. In such schools their Lordships will allow one assistant teacher, in addition to one pupil teacher, for every 100 children.

In the training schools, an exercise in drawing will in future form part of each examination of the students. Their Lordships will seek the assistance of the department of science and art in settling and testing this exercise. In determining certificates, considerable weight will be attached to proficiency in this art.

The examinations of the candidates for Queen's Scholarships will be separated from that of the students. As many qualified students will be nominated (in the order of merit) as answer to the total number of vacancies in all the training schools. The whole number will be comprised in a single list, and each Queen's Scholar so nominated will be at liberty to go to any of the training schools under inspection, the authorities of which may consent to receive him. The principal of each training school will be called upon to make a return to their Lordships of the names of his Queen's Scholars for the ensuing year within twenty-one days after the date of publishing the list.

The students in residence will be classed at the end of each year according to the result of the examinations passed by them, but will not be certificated. No certificate of merit as a teacher is to be granted to the student of a training school until he shall have been for two years in charge of the same elementary school, and shall have been twice reported on as the teacher of it by her Majesty's inspector. Whether he is to be entitled to a certificate or not, and of what class, is to be determined by the tenor of those reports, and by the result of his examination previous to quitting the training school. If the first report be favourable, he will be paid for the first year on the scale of the lowest class. If the second report be favourable, his augmentation and class of certificate will be fixed for the next five years. After which interval, and so on from time to time, the certificate and augmentation will be open to revision, according to the character of the intermediate reports. The value of the certificate will not be fixed in the first instance higher than the first division of the third class for any student who shall have resided less than one year and a half at a training school under inspection.

The grants of £20, £25, and £30, formerly made to each training school, according to the class obtained by the students in the examination, are hereafter to be made on account of those students only who have completed a second year's residence.

Their Lordships rely upon the foregoing provisions, in extension of their Minutes of 1846, to fill a constantly increasing number of elementary schools with certificated teachers. There must, however, for a considerable period, remain a number of teachers disqualified by age for passing the examination for certificates, as well as a number of schools not in a position to obtain certificated teachers, in those parts of the country more particularly which it is the object of the Minute of April 1853 to reach. Their Lordships will institute, therefore, a class of registered as distinguished from certificated teachers. An examination will be held (on the same plan as the late Easter examinations for certificates of merit) by her Majesty's inspectors, at convenient places throughout the country, at some time to be fixed in 1854, and in each following year. The examination will last only three days. The candidates will not be classed, but only passed or rejected. The examination will be confined to simple questions in the following subjects:—1. The Holy Scriptures, the Catechism, and the Liturgy of the Church of England (in schools connected with the Church of England). 2. English History. 3. Geography. 4. Arithmetic (including Vulgar and Decimal Fractions). 5. English Grammar and Composition. 6. The Theory and Practice of Teaching.

Their Lordships conclude their resolutions by observing that they shall require all uncertificated teachers in schools, taking advantage of the Minute of April 2, 1853, or having pupil teachers apprenticed to them, to attend these examinations.

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NATIONAL SCHOOL, MARGATE.

NATIONAL SCHOOL, MARGATE.

Since the introduction of steam-vessels on the River Thames, Margate, as a summer retreat from the smoky atmosphere of the great metropolis, has become the favourite watering-place of the Londoners; and her general prosperity has increased accordingly. In 1801 she was little more than a fishing hamlet, and her population did not exceed 4,766. In 1831 it had increased to 10,339; since which period it has remained nearly stationary.

The expenditure which the citizens of London yearly transferred to the inhabitants of Margate enabled them extensively to improve and adorn the town. Besides her commodious pier and jetty, she now possesses some handsome squares, and many public structures of great architectural importance, especially Trinity Church, which was erected in 1825-7, in the Gothic style of architecture, with a lofty and conspicuous tower 130 feet high. Independently of her churches, she has chapels and meeting houses for almost every religious denomination; and her charitable institutions are numerous—the most extensive being the Royal Sea-bathing Infirmary, founded in 1792.

Though education (at least of a public character) has not perhaps been on a scale commensurate with the increasing prosperity of Margate, still there are many scholastic establishments which reflect credit on the locality. We believe there are twenty-two daily and thirteen boarding-schools, four Sunday schools, and five or six infant schools. Thanet House Academy, and Dane Hill House, are seminaries of the highest respectability.

The National School of Margate, however, has always formed a leading feature in the educational objects of the locality. It was first established as a public school in 1787, for the purpose of clothing and educating forty boys and forty girls; but in 1818 it was placed on the national system, and the clothing of the children discontinued, for the purpose of extending the benefits of general education to 250 children of both sexes. The present edifice, however, which has been recently erected in the district of St. John's, and which the annexed engraving represents, is calculated to accommodate 200 boys and 150 girls. A moveable partition divides the two school-rooms, in order to make one large room, if required. The establishment is also commodiously fitted up with class-rooms and a teacher's residence. The boys' school is fifty feet by thirty, the girls' school thirty-seven by thirty; and the class-rooms, sixteen by fourteen. The parlour, kitchen, and scullery of the teacher's house are each twelve feet square.

The general architecture of the building is of a simple, domestic character, but very appropriate to the objects in view. The bold gable, with its large central window, and three smaller ones, forms the principal façade of the building. The wings, with their bold sloping roofs, have four square windows each, which afford excellent light to the interior. The two turrets, one surmounting the main gable, and the other the principal wing, are very judiciously placed, and greatly contribute to the general architectural effect.

The materials of which the walls are built are Kentish rag, with Bath-stone quoins and stone dressings. The architect is Mr. George Mairs; and Messrs. Jenkins and Smith, of Margate, are the builders. The cost of the whole was nearly £2,000.

ON THE STUDY OF EUCLID.

VI. THE PROPOSITIONS. BOOK I. (*Concluded*).

Proposition XXXII. is among the most interesting theorems of this first book; but an objection to the demonstration of it may be made, the occasion for which had better be removed. You are directed to draw, through the point C, a line C E parallel to A B, by Prop. XXXI.; and it is then inferred that the alternate angles B A C, A C E are equal by an appeal to Prop. XXIX.; but to draw the parallel C E, surely everybody would proceed by making the angle A C E equal to B A C; that is to say, we should first make the alternate angles equal to get the parallels, and should then make use of the parallels to prove the alternate angles equal. You will at once see that we should avoid this circuitous method of proceeding, by making the angle A C E equal to B A C by Prop. XXIII.; and then inferring the parallelism of A B, C E from Prop. XXVII.

The corollaries to this proposition are remarkably beautiful; and the second, especially, cannot fail to excite, in a person who reads it for the first time, a feeling of surprise. It would indeed be a feeling of *incredulity*, if this were possible in geometry. That the sum of the exterior angles, formed by prolonging the sides of a rectilinear figure, should always be *exactly* the same, whether the figure have three sides or three thousand, is a truth so far beyond the reach of practical observation and experiment, and apparently so improbable, that, in the absence of geometry, its existence could scarcely have been suspected, much less established; and yet an argument of half-a-dozen lines produces in every mind the fullest conviction of the fact.

But the corollary that precedes this, though less striking, has, perhaps, the greater practical interest; among other things, we learn from it that—the sum of the angles of a four-sided figure is *twice* as great as the sum of the angles of a three-sided figure; the sum of the angles of a five-sided figure, *three* times as great; of a six-sided figure, *four* times as great, and so on; but the most noticeable practicable inference is, that only *three* regular figures,* namely, the equilateral triangle, the square, and the regular six-sided figure or *hexagon*, can, by repetition, completely cover a surface: in other words that, without leaving any blanks or interstices, we may cover a surface with a mosaic work of equilateral triangles, or of squares, or of regular hexagons, but not with regular figures of any other kind. It would be impossible, for instance, to form a piece of tessellated pavement with slabs of any other regular figure but one of these three; because the uniting together of any other forms, by adjusting side to side, would not fill up the space about the corners—there would be either left an angular gap, or else the stones must over-lap one another. You will readily see the truth of this from the following considerations:—

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* Right lined figures are said to be *regular*, when they are both *equilateral* and *equiangular*.

Let us first consider the equilateral triangle; as the three angles make two right angles, each must be $\frac{1}{3}$ of two right angles, that is $\frac{1}{6}$ of *four* right angles; consequently if *six* equilateral triangles were placed side by side, a corner or vertex of each being at the same common point, all the angular space about that point would be completely occupied; and no one triangle would overlap another, for the angles about a point amount to just four right angles (Prop. XIII., Cor. 2). Let us next consider the square; and, as each angle of a square is a right angle, it is plain that *four* squares, each with a vertex at the same point, when placed in contact, will exactly fill the space about the point.

The figure next in order is the regular *pentagon*, or five-sided figure. The corollary teaches us that the sum of its five equal angles amounts to six right angles; consequently each angle is *one* right angle and *a fifth.* Now you cannot multiply $1\frac{1}{5}$ by any whole number that will make the product 4; no such number exists; in other words, you cannot arrange the angles of pentagons round a point, as the common vertex of all, so as to fill up the *four* right angles about that point; the pentagon, therefore, must be rejected. The next figure is the hexagon. By the corollary, we learn that its six equal angles amount to eight right angles; consequently each angle is equal to $\frac{1}{6}$ of eight right angles; or, which is the same thing, to $\frac{1}{3}$ of four right angles. It follows, therefore, that three regular hexagons, placed side by side, round a point as a common vertex, will exactly fill the space about that point.

We need not extend the examination any further; for, as the sides of regular figures increase in number, the angles increase in magnitude; and, as it has just been seen that *three* angles of a six-sided regular figure make four right angles, more than *two* of a seven, or eight, or nine-sided figure, could never be required; but if *two* equal angles of any figure could make *four* right angles, each angle would equal *two* right angles, which is absurd. It thus follows, that if space about a point is to be filled up by the juxtaposition of regular figures, these figures must be either equilateral triangles, squares, or regular hexagons.

Of these three classes of figures, it is demonstrable, by more advanced principles, that the hexagon will inclose a given amount of space with less extent of outline or border than either of the others; so that if a given surface were to be divided into regular compartments, of equal area, by a network of costly materials, economy, guided by science, would suggest the hexagon as the figure to be chosen. And this is the figure selected by the bee in the construction of the honey-comb. You have seen that of all the figures of geometry, there are but *three* which can so cover a surface as to leave no waste of room—no interstices. The bee chooses one of them. Of these three, the hexagon is that which most economizes material. The bee chooses *it.* It is necessary, too, as well for compactness and strength, as for the safe lodgment of the grub, that the hexagonal cell should terminate in a solid angle. Her choice of angles that *would do,* is to be made from an infinite variety; but among all these, mathematicians have discovered, by a profound analysis, that there is *one*, and but one, mode of formation by which the object would be attained with the least expenditure of materials; and this one the bee adopts. She closes her hexagonal tube with an angular termination, formed by three plane faces. Each plane cuts off or excludes a portion of the tubular space; but the space within the solid angle just makes up for what is thus rejected; and the faces of the solid angle are so shaped, and so inclined, as to fulfil all the mathematical conditions of a *minimum* of surface;

so that while the angular space just compensates for the tubular space cut off, it effects the compensation not only with *less* amount of material, but with the *least* amount possible. The compensating space might be secured in an infinite number of ways. Of this endless variety there is *one* way more economical than any other, and that one is chosen by the bee. You must regard this reference to the architecture of the bee as a digression, into which I have been allured by the preceding examination of Euclid's corollary. But the subject is full of instruction; and when your mathematical knowledge is sufficiently extensive to enable you fully to estimate the science of the honeycomb, you may, like the ancient geometrician Pappus, feel even additional reverence for the Creator's power, and additional gratitude that you have been endowed with faculties to comprehend and admire the exquisite geometry of the bee.*

Proposition XXXVII. may be omitted. It is included in the more general theorem which follows, and which is demonstrated independently of the particular case. What is proved of triangles upon *equal* bases is, of course, proved of triangles on the *same* base.

Propositions XXXV. and XXXVI., about parallelograms, seem to be related to one another, just as these two propositions about triangles are related. But there is a difference; for, although the thirty-fifth is only a particular case of that which follows, yet it is not superfluous, since the particular case is required in the proof of the general theorem. The thirty-ninth proposition, however, like the thirty-seventh, *is* superfluous, as the general theorem which follows does not require its aid. The forty-first, too, might have been replaced by a proposition of wider generality. You can give it the extension here suggested by putting "equal bases" for "the same base" in the enunciation, and modifying the construction and demonstration accordingly.

Proposition XLII. requires a word or two. The line A E is improperly introduced into the construction; you will see, by attending to the details, that the required parallelogram is completed without any aid from this line; it is in the *demonstration* alone that A E becomes necessary, and therefore its introduction should be deferred till the construction is completed.

Of the forty-seventh proposition but little need be said here. It is stated to have been discovered by Pythagoras, who is recorded to have sacrificed a hundred head of oxen to the gods on the occasion: but this is probably fable. The multiplication table has also been generally attributed to the same philosopher; but the modern French geometrician, M. Chasles, in his historical researches, has shown this to be a mistake.

The proposition in question is one of the most important, in its practical applications, of all the theorems of geometry. Many forms of demonstration have been given, but that of Euclid is not to be surpassed in elegance and clearness.

The last proposition is remarkable only for the peculiarity of its demonstration: it is the converse of the preceding, and is demonstrated in the *direct* manner, contrary to Euclid's general practice of demonstrating converse propositions *indirectly*. As an exercise, you may supply an indirect demonstration yourself.

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LESSONS IN FRENCH.

PRONOUNS.

Of the Possessive Pronouns of the Third Person, His, Her, Its, *and* Their (*applied to things*).—The possessive pronouns of the third person singular and plural, when relating to persons, are used in French as in English, except in some cases mentioned in our last, in which the article is used in their stead; but the pronouns *its* and *their* (applied to things) have no distinct equivalent in French, and present some difficulties. (1.) Whenever *its* and *their* (applied to things) are employed in English in the same *proposition* as the noun to which they relate, they are expressed in French by the pronouns of persons, *son, sa,*

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* The investigation of the structure of the honeycomb, by pure geometry, was given, in part, by Pappus in his "Mathematical Collections." It was completed by Maclaurin, in the "Philosophical Transactions;" and is reprinted, with but little alteration, in Creswell's "Treatise on Maxima and Minima;" and with additional illustrations and remarks, in Lord Brougham's "Notes to Paley's Natural Theology."

We may take occasion to remark here, that this interesting subject will be fully investigated, on mathematical principles, in the volume on MATHEMATICAL SCIENCE, forming a portion of the "Circle of the Sciences," announced in this Number.

ses, leur, leurs; as in, The country has its amusements, Le *campagne* a *ses* agréments. These languages have their beauties, Ces *langues* ont *leurs* beautés. Boston and its neighbourhood present to the eye the finest prospect, *Boston* et *ses* environs présentent à l'œil la plus belle perspective. Have you seen Paris, its theatres, buildings, and amusements? Avez-vous vu *Paris, ses* théâtres, *ses édifices,* et *ses* amusements?—(2.) The pronouns *its* and *their* are also expressed by *son, sa, ses, leur,* and *leurs* whenever they are used before a noun governed by a preposition, and referring to something mentioned before or after; as in, It is on account of its climate, soil, and productions, that France is so much admired by foreigners, C'est à cause *de son climat, de son sol,* et *de ses productions,* que *la France* est tant admiré des étrangers. The water was so high that in its course it swept away several houses and trees, *L'eau* était si haute que *dans sa course* elle entraina plusieurs maisons et plusieurs arbres.—(3.) The pronouns *its* and *their* should yet be expressed by *son, sa, ses, leur,* and *leurs,* when the noun before which they are placed, not being qualified by an adjective, and not being in the same proposition as the antecedent of the pronoun, stands as the nominative or the object of a verb after which the preposition *of* is or may be used; as in, This city is magnificent; I admire the beauty of its streets and the splendour of its edifices, Cette ville est magnifique; j'*admire* la beauté *de ses rues* et la splendeur *de ses édifices.* London is a very fine city, although its houses are brick-built, Londres est une très belle ville, quoique *ses maisons soient de* brique.—(4.) But when the possessive pronouns *it* and *their* do not stand in the same proposition as their antecedents, and the preposition *of, de,* does not precede or follow the verb of which the noun they qualify is the nominative or the object, those pronouns are expressed in French by the article *the,* and the personal pronoun *en* accompanies the verb of the proposition in which they stand; as in, These trees are very old, but their fruit is delicious, Ces arbres sont très vieux, mais *les* fruits *en* sont délicieux. Why do you not drink wine? Because I fear its effects, Pourquoi ne buvez-vous pas de vin? Parceque j'*en* redoute *les effets.* I admire this statue; its head is sublime, J'admire cette statue; *la* tête *en* est sublime. Greece was fond of war, although she was aware of its danger, La Grèce aimait la guerre, quoiqu'elle *en* connût *les* dangers. When we live in a country, we must follow its customs, Quand on vit dans un pays, il faut *en* suivre *les* usages. Philadelphia is a fine city; its streets are large and regularly built, Philadelphie est une belle ville; *les* rues *en* sont larges et bien bâties. Although the preceding rules are considered by all grammarians as the laws of good language, many writers have set them aside; but foreigners have no such privilege; every thing for them should be fixed and precise, and the rules we have just given will, in all cases, be a sure guide for them.

Of Possessive Pronouns which are never joined to a Noun.—These pronouns may relate to *one* or *several* persons. Those which relate only to one person as the possessor are, for the first person singular Mine, *le* mien, *la* mienne, *les* miens, *les* miennes. For the second person singular Thine, le tien, la tienne, les tiens, les tiennes. For the third person singular His, her, its, le sien, la sienne, les siens, les siennes. Le mien, le tien, le sien, are singular masculine. La mienne, la tienne, la sienne, are singular feminine. Les miens, les tiens, les siens, are plural masculine. Les miennes, les tiennes, les siennes, are plural feminine. Those which relate to several persons possessing only one object are, First person plural Ours, le nôtre, la nôtre. Second person plural Yours, le vôtre, la vôtre. Third person plural Theirs, le leur, la leur. Le nôtre, le vôtre, le leur, are masculine. La nôtre, la vôtre, la leur, are feminine. Those, in fine, which relate to several persons possessing several objects are, First person plural Ours, les nôtres. Second person plural Yours, les vôtres. Third person plural Theirs, les leurs. *Les nôtres, les vôtres,* and *les leurs,* are of either gender. These pronouns are never joined to a noun, but they relate to one, and cannot be used unless the noun to which they relate has been expressed before; as, I have sold my horse; have you still yours? J'ai vendu mon *cheval;* avez-vous encore *le vôtre?* You destroy your health; I keep mine; Vous détruisez votre *santé;* je conserve *la mienne.* They agree in number and gender with the noun to which they relate.

Merchants, when they correspond with each other, generally do not observe this rule; nothing is more common among them than beginning an answer to a letter by this barbarous phrase:—I have received yours dated such a day. J'ai reçu *la vôtre* datée de tel jour, &c. The word *lettre* not being already expressed, the pronoun cannot be used; the phrase should be turned thus—J'ai reçu *votre* lettre datée, &c.

The personal pronouns are employed instead of the possessive, when nouns of things are used instead of nouns of persons; as, There is no better writer than he, Il n'y a pas de meilleure *plume* que *lui*. There is not in the world a better fencer than you, Il n'y a pas au monde de meilleure *épée* que *vous*. In these two sentences, *plume* is used for *écrivain* (writer), and *épée* for *tireur* (fencer). But if those two nouns were taken in their natural meaning, the possessive pronouns should be employed; as:—There are are no better pens than yours, Il n'y a pas de meilleures *plumes* que les *vôtres*. There is no better sword than yours, Il n'y a pas de meilleure *épée* que la *vôtre*. If in the two first sentences, the possessive pronoun was used instead of the personal, their meaning would be:—There is no better pen than your pen; There is no better sword than your sword,—which is not the idea which the speaker has in mind.

The adjective possessive pronouns are never related to a noun taken indefinitely; as in sentences like the following:—He is not disposed to give *pleasure*, and I am disposed to be benevolent, Il n'est pas d'humeur à faire *plaisir*, et *le mien* est d'être bienfaisant. In the first ages of the world, the father of each family governed it with absolute power. Dans les premiers âges du monde, chaque père de *famille* gouvernait *la sienne* avec un pouvoir absolu. Because a noun employed without an article, or without the equivalent of an article, cannot be followed by a pronoun referring to that noun. The above sentences should be expressed as follows:—Il n'est pas d'humeur à faire plaisir, et moi, je suis d'une humeur bienfaisante. Dans les premiers âges du monde, chaque père de famille gouvernait ses enfants avec un pouvoir absolu.

Of the Possessive Pronouns Mine, Thine, His, Hers, Ours, Yours, *and* Theirs.—*Of the idiomatical expressions,* A (*or* that) friend of mine, A (*or* that) book of yours, *&c.*—Whenever the possessive pronouns *mine, thine, his,* &c., are used after a noun governing the preposition *of*, as, *A friend of mine, Two books of yours,* &c., they form, with that noun, an idiomatical expression, which cannot be rendered literally in French, and should be turned by, *One of my friends, Two of your books;* as in, I have found two books of yours among mine, J'ai trouvé *deux de vos livres* parmi les miens. I met this morning with a friend of mine that I had not seen for ten years, J'ai rencontré ce matin *un de mes amis* que je n'avais pas vu depuis dix ans. But if the noun is preceded by one of the demonstrative pronouns *this, that, these,* or *those,* as in, *That friend of mine, Those books of yours,* the sentence should be altered, and turned by, *my friend, your books,* and the possessive adjective pronouns *my, your,* should be expressed as in the following sentences:—What has become of that friend of yours, Mr. C.? Qu'est devenu *votre ami,* M. C.? What has become of that friend of yours, Mr. C., whom you praised so much? Qu'est devenu *l'ami* que vous vantiez tant, M. C.?

Of the Possessive Pronouns Mine, Thine, His, &c., *used with the Verb* To Be, *to express an idea of* Right, Duty, *or* Turn.—Whenever any of the possessive pronouns *mine, thine, his,* &c., is used with the verb *to be,* to express an idea of *right* or *duty,* it forms with that verb an idiomatical expression, which cannot be rendered literally in French; instead of the possessive pronoun, the preposition *to* is used, followed by an objective pronoun, of the same person and number as the possessive pronoun, and the preposition *of, de,* is used after the objective pronoun, before the next verb; as in, It is mine to command, and yours to obey, *C'est à moi de* commander, et *à vous d'*obéir. The same French expression, *C'est à moi,* is sometimes used to convey an idea of turn; in such case, instead of the preposition *of,* the preposition *to, à,* is used before the verb; as in, It is my turn to play, and not yours, *C'est à moi à* jouer, et non pas *à vous.*

Of the Possessive Pronouns Mine, Thine, His, &c., *used with the Verb* To Be, *and conveying an idea of Property.*—When the possessive pronouns *mine, thine, his,* &c., are used with the verb *to be,* to convey an idea of property, as in, *Is this book yours? Yes,* *it is mine;* they are expressed in French in two different ways. If the thing spoken of, as *book,* in this case, is pointed out singly, and the sentence signify, *Does this book belong to you?* the answer, *It is mine,* only asserts the right of the owner to the property of the book, and is expressed by *C'est à moi,* using a personal objective pronoun of the same person as the English possessive pronoun, with the verb *to be,* followed by the preposition *to.* But if there were several books, and the person who speaks should wish to ascertain which one is the property of the person spoken to, the answer, *Yes, it is mine,* would not only assert the right of the owner to the book spoken of, but would do it to the exclusion of the others; in cases similar to this, the possessive pronoun *mine* is expressed literally in French, and the answer should be, *Oui, c'est le mien;* as in, Is this watch yours? No, it is not mine (meaning only, it does not belong to me.), Cette montre, est-elle à vous? Non, elle n'est pas *à moi.* Is this your watch? No, it is not mine (meaning not only that the watch is not mine, but there exists another watch somewhere, which is mine), Est-ce là votre moutre? Non, ce n'est pas *la mienne.* Are these horses yours? Yes, they are mine, Ces chevaux, sont-ils à vous? Oui, ils sont *à moi.* Are these your horses? Yes, they are mine, Sont-ce là vos chevaux? Oui, ce sont *les miens.* Are these books yours? Yes, they are mine, Ces livres, sout-ils à vous? Oui, ils sout *à moi.*

Of the English Expressions, Of my own, Of his own, &c.—The English expressions, *of my own, of his own,* &c., cannot be rendered literally in French; they should be translated according to the meaning of the sentence, by some equivalent expressions, such as, *which belongs to me, to me, of my composition, of me;* or any other, conveying the same meaning as that of the English sentence; as in, I have a farm of my own in Normandy, J'ai en Normandie une ferme *à moi,* or *qui m'appartient en propre.* I played last night a piece of my own, J'ai joué hier soir un morceau *de moi,* or *de ma composition.* Has not your sister a horse of her own? Votre sœur n'a-t-elle pas un cheval *à elle.* Do not meddle with this; it is no concern of yours (this does not concern you), Ne vous mêiez pas de cela; ce la ne *vous regarde pas.*

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THE MONTHS.—NOVEMBER.

(*Continued from p.* 252.)

2nd.—"*All Souls.*"—To mark the pre-eminent importance of this great Catholic festival, if it happened on a Sunday it was not postponed to the Monday, as was the case with other such solemnities, but kept on the Saturday, *in order that the Church might the sooner aid the suffering souls;* and that the dead might have every benefit from the pious exertions of the living, the remembrance of this ordinance was kept up, by persons dressed in black, who went round the different towns, ringing a loud and dismal-toned bell, at the corner of each street, every Sunday evening during the month; and calling upon the inhabitants to remember the deceased, who were suffering the expiatory flames of purgatory, and to join in prayer for the repose of their souls.

5th.—"*Gunpowder Plot.*"—This day is held in commemoration of the discovery of the "gunpowder plot," A.D. 1605, and the happy deliverance of King JAMES I. and the three Estates of England, from the conspiracy of Guido Fawkes and others, who intended to have destroyed the King, the Prince of Wales, and the Lords and Commons, by igniting a large quantity of powder placed in a cellar beneath the Parliament-house.

School-boys look forward with great anxiety to the celebration of this day, when they will be able to indulge in squibs, crackers, Catherine-wheels, or pin-wheels, and other pyrotechnic displays. Those who are not permitted to join in the festivities of the evening, amuse themselves by looking out of the window at a noisy group of boys, who are carrying an effigy of Guy Fawkes upon a chair from street to street, ever and anon stopping to exclaim—

"Please to remember the fifth of November,
Gunpowder treason and plot.
We know no reason why gunpowder treason
Should ever be forgot!
Holla boys! holla boys! huzza-a-a!"

Night arrives; and then the effigy of Guy, or, as it has now become more common—we cannot say fashionable—to call it, the Pope, is burned in the midst of a great bonfire, and fireworks exhibited in commemoration of the event. A few years ago, a great demonstration took place at Exeter upon this day; but it was calculated to do more harm than good, on account of the party spirit shown upon the occasion.

11th.—"*St. Martin's Day*," or "*Martinmas.*"—St. Martin is said to have been born in Lower Hungary, about 316, and to have originally been a soldier. He is said to have met a beggar, who requested alms; and as St. Martin had not any money, he drew his sword and cut his cloak into two portions, one of which he gave to the beggar, and kept the other himself. The tradition furthermore relates that the supposed beggar turned out to be our Saviour, and that the saint kept the day, and turned hermit. He then had a great many miraculous adventures; and finally, in 371, having been elected Bishop of Tours, is said to have lived in a narrow hole in the side of a rock, and to have died in 397. Martinmas was formerly a quarterly day in England.

13th.—"*St. Brice*," or "*Britius*," was born at Tours, became a monk under St. Martin, and finally succeeded him in the see of that city.

15th.—"*St. Machutus*," sometimes called St. Malo or Maclou, is said to have been born in England, but having visited Brittany, became Bishop of Aleth, where he died 15th November, 565.

23rd.—"*St. Clement*," who was a follower and fellow-labourer with St. Paul, is the patron saint of blacksmiths, and is said to have been thrown into the sea with an anchor fixed about his neck.

25th.—"*St. Catherine*" is said to have been beheaded by order of the Emperor Maxentius, or Maximinius II. Butler, in his "Lives of the Saints," tells us that "she was first put upon an engine made of four wheels joined together, and stuck with sharp-pointed spikes, that when the wheels were moved her body might be torn to pieces;" but she is related to have been delivered from this horrible death by the interference of an angel. The pyrotechnic Catherine-wheel probably took its origin from the tradition we have related.

30th.—"*St. Andrew*," who was one of the apostles, is said to have been martyred in the year 66, at Patræ in Greece, upon a cross of the form of the letter X, which has ever since been called St. Andrew's cross. He is the patron saint of Scotland, and the order of St. Andrew was first instituted by Peter the Great.

No golden summer tints are now spread over the bosom of Nature—no pied carpet of perfumed flowers to lure us from the well-filled library or comfortable breakfast-room—no choir of feathered songsters delights the rambler; for

> "The robin only sings among the bowers,
> Now bare and desolate, his simple lay;
> All other birds are mute and sad, or they
> Have flitted with the spring and summer flowers;
> Yet are the borders not entirely bare."

So we will even brave the chill gusts of wind that blow through yon group of trees, making such a mournful sound, and scattering the few remnant leaves to the mercy of the wind's will—tossing them on high, and whirling them along the deserted paths, leaf-bestrewn—and examine the botanical beauties of the month, though they be few.

Here is the winter cherry (*Physalis alkekengi*), with its pretty red fruit, shining through the thin calyx which surrounds it. The fruit is edible, having a slight acid flavour; but the eatable winter cherry (*P. Peruviana*) has a much more pleasant flavour, and is used for tarts.

Here is a pretty border with the mountain violet (*Viola altaica*); the scarlet lobelia (*Lobilia fulgens*); the gray-leaved birdweed (*Convolvulus Althœoides*); the sweet coltsfoot (*Tussilago fragrans*); and the blue sage (*Salvia Angustifolia*).

Do you observe the Chinese or monthly rose (*Rosa indica*), with its delicate petals, how well it contrasts with the arbutus (*Arbutus Unedo*); and the hardy holly (*Ilex Aquifolium*), the laurel (*Cerasus lauro cerasus*), the Portugal laurel (*Cerasus Lusitanica*) and the poet's laurel, or sweet bay (*Laurus nobilis*). We were hurrying on without observing the Irish heath (*Menziesia Dabeoci*), and the many varieties of Chrysanthemums, among which the Chinese (*Chrysanthemum Sinense*) is conspicuous.

Some birds are arriving from the mountainous parts, and are eagerly looked for by the naturalists; for example, the widgeon (*Anas Penelope*); the poacher (*Nyroca ferina*); the stock-dove (*Columba Ænas*); the golden plover (*Charadrius pluvialis*); and the Bohemian wax-wing (*Bombycilla garrula*). Some few kinds congregate in flocks, such as the skylark (*Alauda arvensis*); the chaffinch (*Fringilla spiza*); the green bird (*F. Chloris*); the house sparrow (*Passer *domesticus*); the starling (*Sturnus vulgaris*); and the fieldfare (*Turdus pilaris*). The wren (*Anorthara communis*), the robin (*Sylvia rubecula*), and the thrush (*Turdus musicus*), often delight us with a short and sweet song, when the weather is fine enough to entice them.

There are few insects to be seen this month, unless it be the red admiral butterfly (*Vanessa atalanta*), and the copper butterfly (*Lycæna Phlæas*), with a few moths, such as the drab day moth (*Diurnea phryganella*); the November dagger moth (*D. Novembris*); the winter moth (*Cheimatobia brumata*); and a few beetles and other insects which are found under old stones, in the manure heaps, and under the bark of trees; among which may be enumerated the wood-boring beetle (*Anobium pertinax*); the great rove beetle (*Goerius olens*); the woodlouse (*Porcellio scaber*); the seven-spotted lady-bird (*Coccinella 7-punctata*); and the millepede (*Julus terrestris*).

The quadrupeds of the month are the stag (*Cervus elaphus*); the roe (*C. capreolus*); the sheep (*Ovis Aries*); the common hare (*Lepus timidus*); the Alpine hare (*L. Variabilis*); and the water rat (*Arvicola aquatica*).

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THE UNEDUCATED POOR.

Of all the afflicting scenes which in large towns are presented at every turn to the eye of the philanthropist and the general observer, the masses of uneducated poverty are the most deplorable. The half-starved ragged little urchins which present themselves at every corner of the streets, and generally in the character of mendicants, are the plague spots of the social system, and at once discreditable to the government and the legislature. Born in the midst of poverty, and unlettered as the wild Indians, they have no principle but vice, and no education but mendicancy or thieving; and until some sweeping legislative measure is enacted for enforcing a general system of education, it will be in vain to hope for any amelioration in the present habits of the lower orders.

The work recently published by Mr. Joseph Kay has in some measure opened the eyes of the community, and cannot fail, ere long, to arrest the serious attention of the government. In one of his papers, "On the Condition and Education of Poor Children in English and German Towns," he offers the following heart-thrilling remarks, which are so appropriate to the subject that we cannot resist the temptation of quoting them entire:—

"If any one will visit those parts of our towns which are inhabited by the poorest classes of labourers, he will see, at almost any hour of the day, great numbers of children of both sexes, from four to sixteen years of age, many of them of rude and coarse manners, and wretchedly clothed, nearly all in a state of disgusting filth, and all exhibiting the marks of poverty, reckless neglect, or thorough degradation. Most of this class are wholly unemployed; numbers are left in the streets while their parents are occupied or from home; many are turned out by careless parents, to get them out of the way, or for the purpose of punishing them; others are idling about, playing in the kennels, indulging in the foulest habits, and learning mischief and wickedness from teachers brought up in a similar school. Some are sent out in the mornings to pick up what they can; others are not allowed to return home at night, unless they bring something back, no matter how obtained; some are regularly trained to beg, and are members of families, the whole of which are busied on appointed stations in the same occupation; many are trained by their own parents to steal; others have no parents, and some no home whatever; some cannot remember when they ever slept at home; and many have no relations they know of in the world. Any one who inquires of the police about these children, will find that many have been in gaol; that some sleep in the horrible and crowded rooms of the low lodging-houses, in company with thieves, beggars, tramps, returned convicts, abandoned women, and all the lowest dregs of society; that others pass their nights in unoccupied cellars, in old or unfinished houses, in out-houses, under arches, in yards, in cabs, in carts, in passages, or in any other spot capable of affording any kind of shelter. These young creatures, during that period of life when their minds are most susceptible and retentive of impressions of all kinds, hear daily the foul language of the worst parts of our towns, and see the most injurious of their spectacles. The vile singing-rooms, penny theatres, gin-palaces, and beer-houses, stand open at every corner, luring them in by thousands, and offering them, in exchange for the first pence they can obtain, scenes as abominable, and stimulants and companions as degrading, as can be conceived. There is nothing, in town life, which is either physically or morally injurious, to which these children are not daily exposed from their tenderest years; there is no influence which is pure and elevating that ever reaches many; while from all this misery and sin most of these poor young creatures have no means of escape, until the police take pity on them. Such is the school in which the parents of vast numbers of our citizens are reared and educated.''

If these appalling facts are not sufficient to rouse the attention of our rulers, we should renounce all hopes of future amelioration; but from the report of the select committee of the House of Commons on criminal and destitute children, dated June 28, 1833, we have the fullest reason for believing that another session will not pass over without the adoption of some stringent public measure to meet the accumulating evils of the present state of things. On the general existence of the evils recapitulated in the preceding extract, the committee appear to entertain no doubt; and they very forcibly express themselves on the necessity of compulsory education. They state that "a great proportion of the criminal children of this country, especially those convicted of first offences, appear rather to require *systematic education*, care, and industrial occupation, than mere punishment.''

The report then proceeds to point out the expediency of some general educational measure, and to prescribe the means by which it might be carried out. It gives the various resolutions of the Committee, the principal of which are, "that various private reformatory establishments for young criminals have proved successful, but are not sure of permanent support, and are deficient in legal control over the inmates; that such penal reformatory establishments ought to be founded and supported entirely at the public cost, and to be under the care and inspection of the Government; that reformatory schools should be established for the education and correction of children convicted of minor offences; that such reformatory schools should be founded and supported partially by local rates and partially by contributions from the state, and that power should be given for raising the necessary amount of local rates; that, irrespectively of the high moral considerations which are involved in this subject, this Committee desire to express their belief, that whatever may be the cost of such schools and establishments, they would be productive of great pecuniary saving, by the effect which they would have in diminishing the sources from which our criminal population is now constantly recruited, and thereby reducing the great cost of the administration of the criminal law; that it is expedient that greater facilities should be given to the guardians of different unions to combine for the purpose of establishing district schools, and that the government should be empowered to assist the unions willing to establish them by partially contributing to the expense of the building; that voluntary contributions have been found inadequate to supply the number of such schools at present required in the metropolis and other cities and towns, and therefore they should not be excluded from the aid of the National Grant, under the distribution of the Committee of Council for Education,—great care being necessary in framing the minute applicable to the description of schools, so as not to fetter private exertions, or to exclude men eminently qualified to fill the laborious and difficult position of teachers by the requirement of too high an educational certificate."

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INORGANIC CHEMISTRY.

CLASS III.—METALS OF THE EARTHS.

XXXII.—CHROMIUM.

Equivalent, 28·14. *Symbol*, Cr. *Density*, 6.

Chromium in combination with iron is rather an abundant substance, particularly in America. The beautiful red chromate of lead is also a natural product in Siberia. The metal, from its great affinity for oxygen, is very difficult to procure. It is a hard, almost infusible substance, resembling cast-iron, nearly insoluble in acids, and does not decompose water. It may be oxidized by fusion with nitre, but does not change in the air.

Chromium forms five compounds with oxygen; of which the sesquioxide (Cr_2O_3) and chromic acid (CrO_3) are the most important. Chromium bears the strongest analogy in its chemical character to manganese and iron. The perfect identity of constitution in the oxides of these three metals is shown in the following tabular arrangement:—

	Protoxide.	Sesquioxide.	Black Oxide.	Acids.	
Manganese forms, ...	MnO	Mn_2O_3	Mn_3O_4	MnO_3	Mn_2O_7.
Iron forms, ...	FeO	Fe_2O_3	Fe_3O_4	FeO_3	
Chromium forms, . . .	CrO	Cr_2O_3	Cr_3O_4	CrO_3	Cr_2O_7.

The Protoxide of Chromium has only very lately been formed by M. Peligot, and is a strong base. It acts in combination like the protoxide of iron, with which it is isomorphous.

The Sesquioxide of Chromium is easily prepared, by treating a boiling and rather dilute solution of bichromate of potash, with an excess of hydrochloric acid, and then with small successive portions of alcohol or sugar, until it assumes a fine emerald green tint. Ammonia in slight excess will now throw down the hydrated oxide as a bulky pale green precipitate, soluble in acids. When this precipitate is dried, it shrinks very much, and on ignition suddenly undergoes a vivid incandescence, and becomes deep green. The sesquioxide of chromium is a feeble base like those of iron and alumina, and may replace them in combination, as in the formation of chrome alum with sulphate of potash. All the salts of this oxide are either emerald green or bluish purple. It imparts a rich tint of green to glass and porcelain, and is the cause of the colour of the emerald.

The Protochloride of Chromium ($CrCl$) is obtained as a white and very soluble substance by the action of dry hydrogen gas on the following compound. The *Sesquichloride* (Cr_2Cl_3) is prepared by passing chlorine gas over an ignited mixture of the sesquioxide and charcoal. It forms a crystalline sublimate of a peach-blossom colour, and is insoluble in water. The sesquioxide dissolves in hydrochloric acid, by the hydrated chloride thus obtained is decomposed by heat.

Chromic Acid (CrO_3) is readily formed by treating a cold and concentrated solution of bichromate of potash with one and a half parts of sulphuric acid. The mixture when cold deposits brilliant ruby-red prisms of chromic acid. The sulphate of potash in solution above, may be turned off, and the chromic acid dried on a porous brick, being carefully covered with a glass to prevent access of organic matters, which at once decompose it. If a little of this acid be thrown into alcohol or ether, the violence of the action is such as to set fire to the mixture. Chromic acid forms numerous salts, which are all highly coloured.

The Chromate of Potash and *the Bichromate* are both familiar examples. The first (KO, CrO_3), is formed on a very large scale by decomposing the native chromic iron with nitrate of potash, by aid of heat. Chromate of potash is dissolved out from the ignited mass, and crystallizes in anhydrous yellow crystals. It is isomorphous with sulphate of potash, dissolves in two parts of cold water, and is the source of all the preparations of chromium.

Bichromate of Potash ($KO, 2CrO_3$) is formed by adding sulphuric acid to a solution of the yellow chromate, when half the potash is removed, and the bichromate crystallizes by slow evaporation in brilliant red crystals of a rhombic form, which are soluble in ten parts of cold water.

Chromate of Lead—Chrome Yellow—(PbO, CrO_3), is the well-known pigment prepared by precipitating the nitrate or acetate of lead by a solution of chromate or bichromate of potash. *Chrome Green* is the oxide of chrome, prepared in a particular way.

Chlorochromic Acid (CrO_2Cl) is a deep red volatile liquid resembling bromine, which appears when equal weights of common salt and bichromate of potash are intimately mixed, and heated in a retort with three parts of sulphuric acid. The chlorochromic acid distils over, filling the receiver with a superb ruby-red vapour. Water decomposes it, forming chromic and hydrochloric acids.

XXXIII. NICKEL.

Equivalent, 29·59. *Symbol*, Ni.

Nickel is rather a rare metal, but may be prepared from the *speiss* or crude nickel of commerce. It is white and malleable, having a density of 8·27, and fuses above 3000°. It is not easily oxidized, and is one of the two or three magnetic metals; magnets may be made of it nearly as powerful as those of iron. Nickel is almost always found alloyed in masses of meteoric iron.

There are two oxides of nickel. The protoxide (NiO) is prepared by precipitating a solution of nickel by caustic potash, which gives a grass-green hydrated oxide, which by heat loses its water and becomes gray. The oxide of nickel is isomorphous with magnesia, and has been obtained crystallized in regular octahedrons. The salts of this oxide have a fine green colour, which they impart to their solutions.

The peroxide of nickel (NiO_3) is a dull black powder, of no particular interest.

The Sulphate of Nickel (MiO,SO_3+7HO) is a finely crystallized salt, occurring in green prisms, which lose their water of crystallization by heat. It forms beautiful well crystallized double salts, with the sulphates of potash and ammonia. Oxalic acid precipitates an insoluble oxalate of nickel from the solution of the sulphate, and the metallic nickel is easily obtained from the oxalate by heat.

Nickel is chiefly employed in making German silver, a white malleable alloy, composed of copper 100, zinc 60, and nickel 40 parts.

XXXIV. COBALT.

Equivalent, 29·52. *Symbol,* Co.

Cobalt is a metal almost always associated with nickel, and closely resembling it in many of its reactions. When pure it is a brittle reddish white metal, with a density of 8·53, and melts only at very high temperatures. It is generally said to be magnetic, but is not so when quite pure. It dissolves with difficulty in strong sulphuric acid, and is not oxidized in air. *It forms two oxides* every way analogous to those of nickel. Its protoxide is a grayish pink powder, very soluble in hydrochloric acid, and forming pink salts. This oxide occurs native.

The Chloride oj Cobalt ($CoCl$) is formed by dissolving the oxide in hydrochloric acid. The solution is pink, and when very dilute may be used as a *blue sympathetic ink,* which may be made green by mixing a little chloride of nickel. Writing made with this on paper is colourless when cold, but becomes of a fine blue or green when gently warmed, and loses its colour again on cooling.

XXXV. ZINC.

Equivalent, 33. *Symbol,* Zn. *Density* 6·86.

Zinc is an important and rather common metal, calamine of carbonate of zinc being found abundantly in many places. The ores of zinc are reduced by heat and charcoal, in large crucibles closed at top, but having an iron tube descending from near the top, through the bottom, and terminating in a vessel of water. The metal being volatile, rises and escapes by the tube into the water. This is called distillation by descent.

Zinc is a bluish-white metal, easily oxidized in the air, and crystallizes in broad foliated laminæ, well seen in the fracture of an ingot of the commercial article. It is called *spelter* in the arts, and is used chiefly to alloy copper in forming brass. Zinc is not a malleable metal, at ordinary temperatures, but at a temperature of between 250° and 300° it becomes quite malleable, and is then rolled into sheet zinc. At 400° it is again quite brittle, and may be granulated by blows of the hammer. At 773° it melts; and if air has access to it, it takes fire, and burns rapidly with a brilliant whitish-green flame, giving off flakes of white oxide of zinc, sometimes called *lana philosophica.* It is completely volatile at a red heat,

The Chloride of Zinc, $ZnCl$, is a salt easily prepared when zinc is dissolved in hydrochloric acid, hydrogen being evolved. *

Sulphuret of Zinc, Blende, ZnS, occurs native in the forms of the first crystallographic class, and is coloured yellow, brown, and black. This is one of the ores of zinc (called black Jack) from which the metal is obtained.

Sulphate of Zinc, or White Vitriol, ZnO, SO_3+7HO.—This salt has the same form as the sulphate of magnesia, and looks extremely like it. It dissolves in 2½ parts of cold water, and forms double salts with the sulphates of ammonia and potash. It is a powerful emetic.

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* This salt, when held in solution, forms the most effectual deodorant yet discovered, which is generally known as "Sir William Burnett's Disinfecting Fluid." This preparation is a solution of chloride of lime.—[Ed. F. T.]

XXXVI. CADMIUM.

Equivalent, 55·74. *Symbol*, Cd. *Density*, 8·65.

Cadmium is generally found associated with zinc, and is almost as volatile as mercury. It is quite malleable, white, and harder than tin. It fuses at 442°, and volatilizes at a temperature a little above this.

XXXVII. LEAD.

Equivalent, 103·56. *Symbol*, Pb. *Density*, 11·35.

This useful and familiar metal occurs in boundless profusion in this country, chiefly as *galena*, or sulphuret of lead, from which the metal is easily obtained by smelting the ore with a limited amount of fuel, at a low heat. The carbonate, phosphate, chromate, and arseniate, are also natural salts of lead much prized by the mineralogists. Lead is a bluish-gray metal, very soft and ductile, but not very tenacious; it oxidizes in the air quite rapidly, forming a coat of oxide, or carbonate, which protects it from further corrosion. Its density is 11·35, and it fuses at 612°; when melted it combines rapidly with oxygen from the air, forming either protoxide, or red oxide, according to the heat.

Lead is slowly acted upon by soft or rain water, and in some cases by hard water; so that it is unsafe to use water-pipes of lead, unless it has been proved by experiment that the particular water in question does not act on this metal. It is a deadly poison, at least in the form of carbonate, which is generally produced under these circumstances.

Lead does not easily dissolve in dilute acids, except in nitric, with which it forms a soluble salt: strong sulphuric acid dissolves it when heated, forming a nearly insoluble sulphate of lead.

There are three oxides of lead, of which only the protoxide has basic properties.

Protoxide of Lead; Litharge, PbO.—This oxide is a yellow powder, formed by slowly oxidizing lead with heat. It is slightly soluble in water, and the solution is alkaline. It fuses easily, and then dissolves silica with great rapidity; hence its use in glazing pottery, and in the manufacture of glass. It forms a large class of definite salts, which have often a sweet taste, as is seen in the acetate or sugar of lead. *The sexquoixide* has the formula Pb_2O_3, and is a reddish-yellow insoluble powder.

The *Peroxide*, PbO_2, is prepared by acting on the *red lead* with nitric acid; it is a puce-coloured body which acts the part of an acid, with bases forming salts.

Red Oxide, or Red Lead, Pb_3O_4.—This is a common pigment, and is formed when melted lead is exposed to a temperature of 600° or 700°. It is of variable constitution, according to the temperature at which it is prepared. Acted upon by hydrochloric acid, it evolves chlorine, and with sulphuric acid, oxygen is given off. It is preferred to litharge for glass making.

Carbonate of Lead; White Lead; PbO, CO_2.—This salt is found beautifully crystallized in nature, but is prepared artificially in very large quantities, for the purposes of a paint. This pigment is obtained by casting lead in very thin sheets, which are then rolled up into a loose scroll, and placed in a pot over a small quantity of vinegar, and so arranged as not to project above the pot, nor touch the vinegar. Many thousands of these pots are arranged in successive layers over each other, with boards between, and the interstices filled with spent tan, or fermenting stable dung, which gives a gentle heat to the acid. After a time the lead is completely converted into an opaque white crust of carbonate. The theory of this process will be explained when we describe the acetates of lead (organic chemistry.)

XXXVIII. URANIUM.

This is a very rare substance, found only in *pitch-blende*, *uranite*, and a few other rare minerals. Its chemical history is, however, possessed of considerable interest. There are three oxides of uranium—viz., UO_2, U_2O_3, and U_4O_5. The metal is usually obtained as a dark powder, but can be condensed into a white malleable form. It forms beautiful yellow salts. The phosphate of uranium and copper (*uranite*) is one of the most beautiful of minerals.

EDUCATIONAL AND SCHOLASTIC MATTERS.

MR. COBDEN ON POPULAR EDUCATION.

It is a gratifying phase in society, to witness public men entering with enthusiastic spirit into the great necessity of the age—the general diffusion of popular education. When they apply their intellectual powers to the promotion of so useful an object, they are assuredly entitled to the gratitude of mankind. At the late opening of the Barnsley Mechanics' Institute, Mr. Cobden not only officiated as president of the evening, but as a public teacher, and delivered a kind of inaugural address, embodying all the leading principles of popular education, and showing the general ignorance which unfortunately pervades the masses of society. In this address, Mr. Cobden demonstrated to the assembled audience, that education was necessary, not merely as a point of personal honour, but as the most essential means of securing and advancing their individual interests, as intelligent and efficient members of society. While urging the diffusion of general education, the honourable gentleman thus spoke of the lamentable state of ignorance which pervaded the industrial classes:—

"I cannot," he observed, "accept statistics to prove the number of people who attend schools—to prove that the people are educated, because I cannot shut my eyes to what is evident to my senses—that the people are not educated—that they are not being educated. I was talking only yesterday with a merchant in Manchester, who told me that he had attended at the swearing in of the militia in one of the largest manufacturing towns of England, and that not one-half of those sworn in could read, and not one-third could sign their names. I was talking this subject over to an old friend of mine at Preston, and he said, 'I attended the coroner one day last week at an inquest. There were thirteen jurymen; five signed their names, and eight made their mark!' Can I shut my eyes to what is going on around us? I cannot, and therefore I say we are not an educated people; and I say it is our duty, and our safety calls upon us, to see that the people are educated. I have no hesitation in asserting that, in point of school learning, the mass of the English people are the least instructed of any Protestant community in the world. I remember quite well, at the time of the Hungarian emigration into this country after the revolution, a very distinguished minister or religious teacher of Hungary was talking to me on the subject of our education, and I told him a large portion of our people could neither read nor write. He could not believe it, and said, 'If it is true a large proportion of your people can neither read nor write, how do you maintain your constitutional franchises and your political liberties? Why, it is evident to me that your institutions are rather ahead of your people, and that this self-government is only a habit with you.' It is a habit, and we will cling to it and hold it; but I want a safer foundation. I want to have our self-government a habit of appreciation—something our people will be proud of, and not simply a habit; and there is no security unless it is based upon a wider intelligence of the people than we meet with at the present moment. It meets us at every turn—you can't do anything in social reform but you are met with the question of education. Take the question of sanitary reform. Why do people live in bad cellars, surrounded by filth and disease? You may say it is their poverty; but their poverty comes as much from their ignorance as their vices—and their vices often spring from their ignorance. The great mass of the people don't know what the sanitary laws are; they don't know that ventilation is good for health; they don't know that the miasma of an unscavengered street or impure alley is productive of cholera and disease. If they did know these things, people would take care they inhabited better houses; and if people were only more careful in their habits than they are, and husbanded their means, they might get into better houses."

Mr. Cobden then proceeded to institute a comparison between the people of England, and those of the United States, in point of education, and gave the palm to the latter. He stated the substance of a communication made by a scientific gentleman who was selected by the government to go out to America to report on the Great Exhibition in New York. He had found in America a degree of intelligence among the manufacturing operatives, and a state of things in the mechanical arts, which have convinced him that, if we are to hold our own—if we are not to fall back in the rear in the race of nations—we must educate our people so as to put them upon a level with the more educated artizans of the United States. But why should America be better educated than England? Do you think that a new country, which has the wilderness to cultivate, primeval forests to level, roads to make, and every bridge and church to erect,—do you think that such a country is in a position to rival an old country, if that country will only do its duty to its people? No, an old country has greater advantages and facilities at command than a new one; and if you find a new country beating an old one in this matter, depend upon it, it is because of some fault in the old one. We don't read in ancient Greece, when she sent forth her colonies, that they became the teachers of the mother country. No; Athens always remained the teacher of the whole world. And it is a shame if a new people, sent out from us only yesterday, is to be held up for our admiration and example, and this too in the matter of education. Now I hope that it won't be said that there is anything in these remarks which is out of place in an assembly such as this. It appears to me that if there can be a meeting at which such an object as this should be discussed, it is just such a meeting as this. We are all here, at all events, presumed to feel a great interest in the subject of education, and therefore anxious to promote it. And I don't despair even now. I should not despair of this country, if the people of this country would only resolve to do it, surpassing all the world in education in a generation or two."

SCHOOLMASTERS IN BAVARIA.

In Bavaria the public schools are under the protection and authorization of the government; and the king appears to take great interest in their prosperity. On a late occasion his majesty added an increase to the salaries of the national schoolmasters. On his receiving an address of thanks he immediately returned the following gracious reply:—"I thank you, gentlemen, and am rejoiced if, by what I have done, you will find that I am a friend to schoolmasters, and that I honour and esteem your profession; not only do I esteem, but I love it. I admit that your mission is arduous and difficult, and that to fulfil it requires angelic patience. Occupy yourselves with the education of the people, for it is in a great measure in your hands; disseminate useful knowledge in every direction, for it is that which forms a moral and a faithful people. Tell your colleagues that I love them, and that the king pledges you his word that he will do everything that is possible for you."

HYDE PARK COLLEGE FOR YOUNG LADIES.

At a late meeting of the friends and promoters of this institution, held at the college in Westbourne-terrace, at which were present the Rev. J. S. Boone, President, and Dr. Playfair, Vice-president, an interesting report of its successful progress was read by the Secretary. It stated that scarcely eleven months had elapsed since the idea of establishing a college for ladies in the neighbourhood was first suggested to the gentlemen who now formed the committee; that within two months after the first meeting, both the senior and junior departments were opened, and the classes in full operation. The number of pupils entering the senior department in the first term amounted to 119, making a total of pupils attending on all classes of 215. The success was equally encouraging in the junior classes. The first half-year there were 14 pupils, the second quarter 33, the third 19, and there are at present 38, with every prospect of increase. The same professors attend, with very little difference, in both departments. After the reading of the report, Dr. Playfair said that he hailed the establishment of this ladies' college as a material type of civilisation; it was a greater compliment paid to woman than could be paid to her beauty, when they thought of her intellectual improvement. Women were the true educators of society, and therefore the greater the necessity to bring them up in a manner more commensurate with the spirit of the age. He observed on the programme of subjects taught, viz., botany, chemistry, and natural philosophy, which many might fancy were not fitted for the education of women; but they were eminently so to them, as the educators and nurses of the human race.

SOUTH DEVON AND EAST CORNWALL SCHOOLMASTERS' ASSOCIATION.

A society has been established under the above title, and the rules for its general guidance have been published; according to which, all teachers in Protestant day-schools, residing in South Devon and East Cornwall, are eligible to become members; and general meetings of the association are to be held at Plymouth. A library is to be established for the use of the members, and classes are to be formed for the study of mathematics, languages, or any branch of English literature.

SCOTCH UNIVERSITIES.

The new act to regulate the admission of professors to the lay chairs in the Universities of Scotland, is now in force. It is not now necessary for any person who shall be presented to the office of professor Regent, master, or other office in the Universities or Colleges in Scotland, to make and subscribe the acknowledgment or declaration mentioned in an act passed by her Majesty Queen Anne, entitled "An act for securing the Protestant Religion and Presbyterian Church Government." The declaration substituted is to the effect that the person will never endeavour, directly or indirectly, to teach or inculcate any opinions opposed to the Divine authority of the Holy Scripture, or to the Westminster confession of faith, as ratified by law in the year 1690; and that he will not exercise the functions of the office to the prejudice or subversion of the Church of Scotland as by law established, or the doctrine or privileges thereof.

NEW SCHOOLS.

A new School has recently been erected at Bildeston. It is built in the style of the 13th century, with a small bell-tower, surmounted with a Greek cross. The school-room measures 50 feet by 17; with a class-room, forming a south transept, 12 feet by 11.—St. Laurence's parochial schools, at Reading, were lately opened by the Bishop of Oxford, for the accommodation of 280 boys and girls. There are two school-rooms, each 54 feet by 18, and two rooms, 20 feet by 14. The style of architecture is early English. The materials are flint, rubble, and Bath-stone dressings.

THE EDITOR AND HIS CORRESPONDENTS.

Orr's "Circle of the Sciences."—We have been favoured with the Editor's "Introduction" to this important undertaking; and we do not hesitate to say, that if he succeeds in accomplishing all that he professes, the work will be one of the most popular, the most useful, and the most important, in a scientific as well as a national point of view, which has ever yet issued from the press. It is to consist of a series of popularly written Treatises, which (as the Publishers state in their brief address appended to the present cover of the "Tutor") "will comprehend every useful and attractive section of human acquirement, whether scientific, practical, or descriptive, and be issued at a price so moderate as to place them within the reach of every member of the community."

Pronunciation of Latin — Rogatus. — The pronunciation of the Latin language, and the discrepancies existing between the English and the continental nations, is a subject of too extensive a nature to be discussed in a single paragraph. Each nation adopts its own peculiar pronunciation; especially of the three vowels *a*, *e*, and *i*, in which the English differ from all the rest. They pronounce them as they are accustomed to do in their own tongue, which often produces a very cacophonous effect, especially in the reading of Latin poetry, the rhythmus being perpetually violated, even by the first scholars. Thus *nivĕs*, in the beautiful Horatian ode, "Diffugere nives," which ought to be read iambically, is barbarized into a sound something like *kniv-es*. As the subject, however, is of great interest to the admirers of the Latin muse, we shall probably enter upon it more at length in a future number.

The Slide—or Sliding-rule—T. Mollard.—We perfectly agree with our correspondent, when he says that "scarcely one out of twenty knows how to work the sliding-rule, and apply it to his business." It is an instrument for the mechanical performance of the simple rules of arithmetic by the use of logarithmetic scales, and though invented in this country it has been greatly undervalued. Some recent French writers have assured their readers that in England "the sliding-rule is taught at schools at the same time with the letters of the alphabet;" but we feel safe in saying that nine Englishmen out of ten would not know the use of the instrument if they saw it; and that of those who even know what it was for, not one in a hundred would be able to work a simple question by its means. For a few shillings, however, most persons might put into their pockets some hundred times as much power of calculation as they have in their heads; and the use of the instrument is attainable without any knowledge of the properties of logarithms, on which its principle depends. At some future time we shall enter upon the subject; but at present we must content ourselves with merely referring our correspondent to an excellent article, illustrated with diagrams, which appears in the 22nd volume of the "Penny Cyclopædia."

Decimal Coinage.—The editor of the "Home Companion," who recently extracted a passage from Dr. Nuttall's article, in p. 153, on the "Centesimal System of Money," has favoured us with a communication from Mr. H. Perkins, of Manchester, who has just published a little brochure, under the title of "Pounds, Dims, Cents, and Mils." The author has also forwarded his pamphlet for perusal, and expresses his regret that such a system as the one which appeared in our pages should have been advocated. We have carefully perused the lucubrations of the writer; and it appears manifest to us that his proposed system of *pounds*, *dims*, *cents*, and *mils*, is of a more complicated character than even the present one now in use. The terms *dims* and *mils* are very objectionable; and four denominations of money are equally so; as it would require considerable time and difficulty to bring them into practical use. Moreover, they could not be adapted to the existing coinage; and the adaptation of the coinage to Mr. Perkins' system would be attended with great difficulties. His objections to the two simple denominations of pounds and florins, with the centesimal parts of the florin, are purely imaginary; for a similar system has been long in operation in France, Holland, and America, and been found to work admirably. The same sum, however, which would be briefly expressed in pounds and florins, could also be elaborated into four denominations, if preferable. Thus 2*l.* 2·61*fl.*, instead of being simply expressed as two pounds, two-sixty-one florins, might be elaborated into 2*l.* 2*d.* 6*c.* 1*m.*, or two pounds, two dims, six cents, and one mil! But it would be too long-winded a story for the common monetary transactions of life.

C. S. D.—Your questions are purely geometrical, which could not be elucidated without correct diagrams and a mathematical process of working.

G. F. Burdlots.—The wires of a galvanic battery are copper.

A Zealous Botanist may rest assured that every care will be devoted to the work on "British Plants," to render it worthy of the scientific spirit of the age.

NATURAL PHILOSOPHY.

Second Division.

THE PROPERTIES OF HEAT—THERMOTICS.

CHAPTER L.

CONDUCTION AND EXPANSION.

Good and Bad Conductors of Heat—Differences among the Metals—Conduction and Circulation in Liquids—Point of Application of Heat—Case of Gases—Expansion of Gases, Liquids, and Solids—Irregularity of Expansion in Liquids and Solids—Regularity of Gases.

When one end of a metallic bar is placed in the fire, after a certain time the other has its temperature elevated, and the heat is said to be conducted. It finds its way from particle to particle,—from those that are hot to those that are cold.

But if a piece of wood or of earthenware be submitted to the same trial, a very different result is obtained. The farther end never becomes hot; proving, therefore, that some bodies are good and others bad conductors of heat.

The rapidity with which this conduction from particle to particle takes place, depends, among other things, upon their difference of temperature. Thus, when the bulb of a thermometer is plunged in a cup of hot water, for the first few moments its column runs up with rapidity; but as the thermometer comes nearer to the temperature of the water, the heat is transmitted to it more slowly.

Of the three classes of bodies, solids are the best conductors, liquids next, and gases worst of all. Of solids, the metals are the best, and among the metals may be mentioned gold, silver, copper. Among bad solid conductors we have charcoal, ashes, fibrous bodies—as cotton, silk, wool, &c.

That the metals differ very much in this respect from one another, may be satisfactorily proved by taking a rod of copper, one of brass, and one of iron, *b c d*, Fig. 301, of equal length and diameter, and screwing them into a solid metallic ball, *a*, having placed on their further extremities at *b c d*, pieces of phosphorus, a very combustible body. Now, if a lamp be placed under the ball, it will be found that the heat traverses the metallic bars with very different degrees of facility, and the phosphorus takes fire in very different times; the first that inflames is that on the copper; then follows that on the brass, and, a long time after, that on the iron.

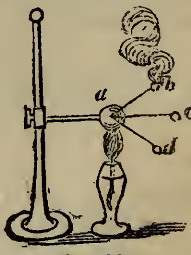

Fig. 301.

Liquids are, for the most part, very indifferent conductors of heat. This may be established, for example, in the case of water, by taking a glass jar, *a*, Fig. 302, nearly filled with that substance, and introducing into it the bulb of a delicate air-themometer, *c*, so that a very short space intervenes between the top of the bulb and the surface of the liquid. If now some sulphuric ether be placed on that surface, and set on fire, it will be found that the thermometer remains motionless, and we therefore infer that the thin stratum intervening between the burning ether and the thermometer, cuts off the passage of the heat. More delicate experiments have, however, proved that the liquid condition is not, in itself, a necessary obstruction. Even water does conduct to a certain extent; and quicksilver, which is equally a liquid, conducts very well.

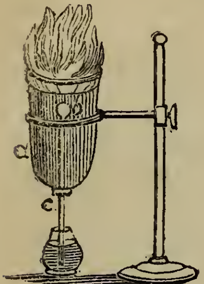

Fig. 302.

But experience assures us that, under common circumstances, heat is uniformly disseminated through liquids with rapidity. This, however, is due to the establishment of currents in their mass. We have seen how readily this class of bodies expands under an elevation of temperature, and this explains the nature of the passage of heat through them. When the source of heat is applied at the bottom of a vessel containing water, those particles which are in immediate contact with the bottom become warmed by the direct action of the fire, and they therefore expand. This expansion makes them lighter, and they rise through the stratum above, establishing a current up to the surface. Meantime their place is occupied by colder particles, which descend, and these in their turn become warm, to follow the course of the former. Circulation, therefore, takes place throughout the liquid mass, in consequence of the establishment of these currents; and all parts being successively brought in contact with the hot surface, are all equally heated. That these movements do take place, may be proved by putting into a flask of water, *a*, Fig. 303, a number of fragments of amber, adding a little glauber salt, to make the specific gravity of the liquid more nearly that of the amber, and then applying a lamp, currents are soon set up, and the amber, drifting in them, marks out their course in an instructive manner.

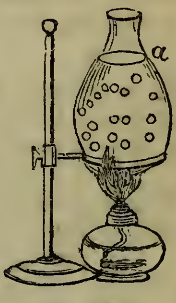

Fig. 303.

Such currents, however, wholly depend on the point of application of the heat. If the fire, instead of being applied at the bottom of the vessel, is applied at the top, as in Fig. 302, then the liquid can never be warmed. The cause of the movements of particles is their becoming lighter—they therefore float upward; but if they are already situated on the surface, of course no movement can take place.

With respect to gases, we observe the same peculiarity that we do with liquids. Strictly speaking, they are very bad conductors of heat; but, from the mobility of their parts, it is very easy to transfer heat readily through them, provided it is rightly applied. The experiment represented in Fig. 304, shows how easily circulation takes place in them. If a piece of burning sulphur be put in a cup, *a*, and a jar full of oxygen be inverted over it, the combustion goes on with rapidity, and the light smoke that rises marks out very well the path of the moving air. It rises directly upward from the burning mass, until it reaches the top of the jar, and then descends in circular wreaths to the bottom.

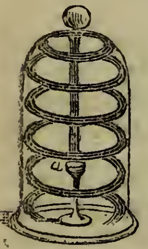

Fig. 304.

CHAPTER LI.

CAPACITY FOR HEAT AND LATENT HEAT.

Illustration of the Different Capacities of Bodies for Heat—Standards employed—Process by Melting—Process of Mixtures—Effects of Compression—Effect of Dilatation—Latent Heat—Caloric of Fluidity—Caloric of Elasticity—Artificial Cold.

By the phrase "capacity of bodies for heat," we allude to the fact that *different bodies require different degrees of heat to warm them equally.*

An experiment will serve to illustrate this important fact. If we take two bottles as precisely alike as we can obtain them, and, having filled one with water and the other with quicksilver, set them before the same fire, so as to receive equal quantities of heat in equal times, it will be found that the water requires a very much longer exposure, and therefore a larger quantity of heat than the quicksilver, to raise its temperature up to the same point.

Or if we do the converse of this, and take the two bottles filled with their respective liquids, which, by having been immersed in a pan of boiling water, have both been brought to the same degree, and let them cool freely in the air, it will be found that the water requires much more time than the quicksilver to come down to the common temperatures. It contained more heat at the high temperature than did the quicksilver, and required more time to cool; it has, therefore, a greater capacity for heat—or, to use a loose expression, at the same temperature, holds more of it.

There are several different ways by which the capacity of bodies for heat may be determined. Thus we may notice the times they require for warming, or those expended in cooling in a vacuum. Of course we cannot tell the absolute amount of heat which is contained in any substance whatever, and these determinations are hence relative—different bodies being compared with a given one which is taken as a standard. For these purposes water is the substance selected for solids and liquids, and atmospheric air for gases and vapours.

There is reason to believe that the atoms of all simple substances have an equal capacity for heat; and that all compound bodies, composed of an equal number of single atoms combined in one and the same manner, have a capacity for heat which is inversely as their specific gravity.

When a solid substance passes into the liquid form, a large quantity of heat is rendered latent—that is to say, undiscoverable to the thermometer. Thus we may have ice at 32° and water at 32°, the one a solid and the other a liquid; and the precise reason of the physical difference between them is, that the water contains about 140°, which the ice does not—a quantity which is occupied in giving it the liquid state, and is insensible to the thermometer.

For this reason the transformation of a solid into a liquid is not an instantaneous phenomenon, but one requiring time. Ice must have its 140° of latent heat before it can turn into water. And, conversely, the solidification of a liquid is not instantaneous. It must have time to give out the latent heat to which its liquid state is due.

When a liquid passes into the form of a vapour, it is the presence of a large quantity of latent heat which gives to it all its peculiarities. Thus water, in turning into steam, absorbs nearly 1,000° of latent heat; and, when that steam reverts into the liquid state, the heat re-appears.

To the caloric which is absorbed during fusion, the designation of *caloric of fluidity* is given,—to that which gives their constitution to vapours the name of *caloric of elasticity*. And, as different bodies require during these changes different quantities of heat, there are furnished, in the works on chemistry, tables of the caloric of fluidity, and caloric of elasticity of all the more common or important bodies. Of all known bodies water has the greatest capacity for heat; and, in consequence of the great amount of latent heat it contains, it is one of the great reservoirs of caloric, both for natural and artificial purposes.

Hence, whenever a substance melts, it absorbs heat, and when it solidifies it gives out heat. When a substance vaporizes it absorbes heat, and when a vapour liquefies it evolves heat.

CHAPTER LII.

ON EVAPORATION AND BOILING.

Phenomena of Boiling—Effect of the Nature of the Vessel and the Pressure—Height of Mountains Determined—Effect of Increased Pressure—Evaporation—Evaporation in Vacuo—Effect of Temperature on a Liquid in Vacuo—Explanation of Boiling—Nature of Vapours.

As the vaporization of liquids is connected with some of the most important mechanical applications, we shall proceed to consider it more minutely.

When water is placed in an open vessel on the fire the temperature of the whole mass ascends on account of the currents described in Chapter L. After a time, minute bubbles make their appearance on the sides of the vessel; these rise a little distance, and then disappear; but others soon take their places, and the water, being thrown into a rapid vibratory motion, emits a singing sound. Immediately after this, the little bubbles make their way to the surface of the liquid, and are followed by others which are larger, and the phenomenon of boiling takes place. The heat has now reached 212°, and, it matters not how hot the fire may be, it never rises higher.

Different liquids have different boiling points, but for the same body, under similar circumstances, the point is nearly fixed. It is, indeed, in consequence of this that the boiling of water is taken as the upper fixed point of the thermometer.

Of the circumstances which can control the boiling point, two may be mentioned: the nature of the vessel and the pressure of the air.

In a polished vessel, for instance, water does not boil until 214°; but, if a few grains of sand or other angular body is thrown in, the temperature sinks to 212°.

The absolute control which pressure exerts over the boiling point may be shown in many different striking ways. Thus, if a glass of warm water be put under the receiver of an air-pump and exhaustion made, the water enters into rapid ebullition, and continues boiling until its temperature goes down 67°. Water placed in a vacuum will, therefore, boil with the warmth of the hand.

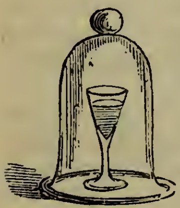
Fig. 305.

Advantage has been taken of this fact to determine the height of accessible eminences. For, as we ascend in the air, the pressure necessarily becomes less; the superincumbent column of the atmosphere being shortened, the boiling point therefore declines. It has been ascertained, that if we ascend from the ground through 530 feet, the boiling point is lowered one degree; and formulas are given by which, from a knowledge of that point, in any instance the altitude may be calculated.

On the other hand, when the pressure on a liquid is increased, its boiling point ascends. This may be proved by taking a spherical boiler, *a*, properly supported over a spirit lamp, there being in its top three openings; through *d* let a thermometer dip into some water which half fills the boiler; at *b* let there be a stop-cock which can be opened and shut at pleasure, and through a third opening between these let a tube, *c*, pass, dipping down nearly to the bottom of the boiler into some quicksilver which is beneath the water. Now let the water boil freely and the steam escape through *b*, the thermometer will mark 212°. Close the stop-cock so that the steam cannot get out, but, being confined in the boiler, exerts a pressure on the surface of the water, which is indicated by the rise of the mercury in the tube. As the column rises the boiling point rises, and if the instrument were adopted to show the results for high pressures, it might be proved that the boiling point—

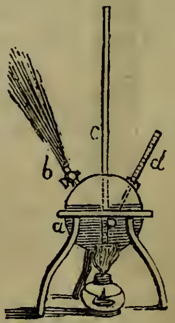

Fig. 306.

For 1	atmosphere is	212°	For 10	atmospheres is	358.8
2	"	250.5	15	"	392.8
3	"	275.2	20	"	418.5
4	"	293.7	40	"	666.5
5	"	307.5	50	"	690.7

Besides this escape of vapour from liquids during the act of boiling, the same is continually going on in a slow and motionless way, at lower temperatures. If some water be left in a shallow vessel exposed to the air, after a short time it all disappears. To this phenomenon the term evaporation is given.

At one time it was supposed that the atmospheric air acted on evaporating bodies by an affinity for their vapours, in the same way that a sponge will soak up water. But the fallacy of this idea is proved by the fact that evaporation goes on more rapidly in vacuo, where no body whatever is present, than in the air. Thus, if into the torricellian vacuum of a barometer, we pass a little ether, alcohol, or water, the moment they reach the void they instantly give forth vapour, and the mercurial column is depressed. With ether the depression is greatest, with alcohol less, and with water least of all. Now when we consider the nature of the barometer, and the force which keeps the column of mercury suspended in it, it is very clear that this simple method affords us an easy means of knowing the elastic force of the vapours evolved from any of these substances: for the mercurial column is depressed through the operation of that elastic force. It is this which forces it downward, while the pressure of the air tends to force it upward.

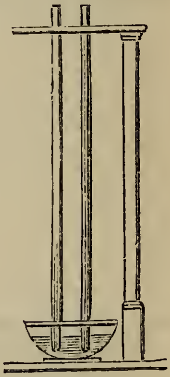
Fig. 307.

By thus introducing liquids into the barometric tube, we have the means of determining the elastic force of the vapours to which they give rise; and very simple experiments satisfy us that that elastic force depends upon the temperature. If we warm the tube, Fig. 307, by moving over it the flame of a spirit-lamp, the depression becomes greater; and if we surround it by means of warm water in a wider tube, so as to be able to ascertain with accuracy the temperature applied, we shall discover that as the heat rises the elastic force of the vapour increases, and that *the mercurial column is wholly depressed into the cistern as soon as the temperature has reached the boiling point of the liquid on which we are operating.*

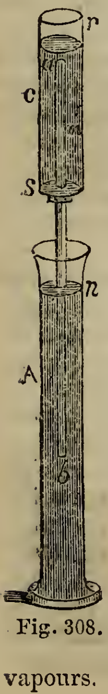

Fig. 308.

Thus, let A be a deep glass-jar, filled to the height *n* with mercury, and let *a b* be the barometric tube, into the vacuum of which, at *m*, the liquid under trial has been passed. Let a wide tube, *r c*, capable of holding hot water, be adapted, by means of a tight-fitting cork, at *s*, to the barometric tube. Now if, having observed the depression which the mercury exhibits at common temperatures, we fill the tube, *r c*, with hot water, a still greater depression is the immediate result. The temperature of the hot water, and therefore of the liquid in the barometer, can easily be determined by plunging a thermometer into the tube, *r c*.

From such experiments, therefore, we draw this important conclusion:—*The elastic force of vapour rising from a liquid at its boiling point is equal to the pressure upon it.* If the ebullition be taking place in the open air, it is, therefore equal to the pressure of the air.

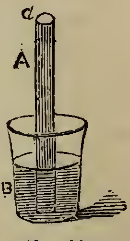

Fig. 309.

With respect to the nature of vapours, there is a good deal of popular misconception. Many persons suppose that they are naturally of a smoky or hazy aspect. But if we repeat the experiment represented in Fig. 309, and formerly described in Chapter VI., we shall find that so far as the vapour of ether is concerned, it is perfectly transparent, like atmospheric air, and by proper examination the same may be verified for all other vapours. The true peculiarity is the facility with which this form of bodies assumes the liquid state. The moment the pressure of the air is restored, in this experiment, the ethereal vapour collapses into the liquid condition.

The same fact may be illustrated in another way. If we take a mattrass, *a*, Fig. 310, and fill the bulb and tube of it with water, and then introduce a little sulphuric ether into its upper part, the mouth dipping beneath some water contained in a jar, on heating the bulb by a spirit-lamp, the ether presently vaporizes. It may now be remarked—1st, that a vapour occupies a great deal more space than the liquid from which it comes; 2nd, That it has not a misty appearance; 3rd, That, under a reduction of temperature, it collapses into the liquid state—for, on removing the lamp, and suffering the bulb to cool, the vapour disappears.

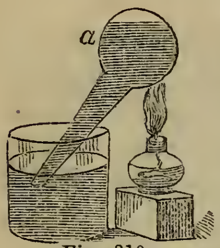

Fig. 310.

Either by diminution of temperature or increase of pressure, vapours may be condensed into the liquid state, and in this consists the chief distinction between them and gases.

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ON THE LAWS OF DESIGN.

> "Art is wondrous long;
> Yet to the wise her paths are ever fair,
> And patience smiles, though genius may despair."
> HOLMES.

A CAREFUL study of the productions of those particular periods when ornamental art appears to have been best understood, and an appreciation of the beautiful the most generally diffused amongst the various classes of society, teaches us that an artist's success invariably depends on the recognition of certain fixed principles, the neglect of which is found quite sufficient to account for much of the failure and disappointment attending the production of many of the most costly and elaborate works of the present day.

Before, however, proceeding to inquire into their nature and the laws by which they are governed, let us for a moment consider the chief *motive* which influenced the *ancient* artists in their respective productions, and see if we can thereby obtain any clue to the varying degrees of excellence and inferiority so plainly discernable.

History teaches us, that the periods most conducive to success in the arts were clearly those in which a general simplicity distinguished the manners and customs of mankind, when excellence alone was the prevailing object sought after in the production of all that was worthy of notice in ordinary life. The existing remains of Greek and Roman art fully illustrate this fact; it being well known, by those conversant with the subject, that all the most admirable specimens we possess belong to the purer and best stages of society in those countries: and that, as the wealth and power of the people increased, and luxury, with his attendant train of morbid desires, became general, the great retrogression is discernible. Frivolous novelties in dress and accomplishments being found to take the place of that honourable striving after the true and great, which is, to this day, so prominent a feature in their earlier and best productions.

We therefore take it as a general rule, that, as long as simplicity and excellence of design is the chief aim of the artist, all goes well; but the moment this is lost sight of, and a morbid craving for novelty appears, we begin to find innovations of all kinds rapidly succeeding one another, each in its effects more and more at variance with good taste and correct principles.

Let us now apply this to ourselves, and see what are the *motives* which influence the efforts of the *modern* producer. In the first place, let us inquire what is the principal and most urgent cry of all the great manufacturers and producers who surround us. Is it not a cry for "novelty?" It is not, "give us something good, and chaste, and beautiful;" but, "give us something striking, something new, something hitherto unheard of, no matter what!" Hence follow the numerous anachronisms and gaudy trifles of the day. Distinctions of style and form are lost sight of; and incongruous materials mingled together. Colour is forced to the utmost verge of the scale; so that, in the end, we find even blue, and scarlet, and yellow not brilliant enough for the purposes required of them. This cry after novelty is the master-vice of the age in all matters relating to art and decoration; and until its unmeaning dictates cease to be the principal and only rule and aim of producers, our progress is next to hopeless.

We do not, however, say that novelty, *per se*, is to be deprecated; on the contrary, we affirm it to be most requisite, nay, even indispensable; but we are most anxious to impress upon our readers the necessity of that due regard to those just principles of beauty in ornament and design, without which the newest of novelties must ever be imperfect, and more or less worthless. The laws of design are as fixed and imperious in their peculiar province, as those of the most absolute monarch in his widely-spread dominions; and neither the one nor the other can be infringed with impunity. It most not, however, be supposed, that the tendency of correct laws and principles, in design, is to cripple and circumscribe the legitimate field for invention. The man of genius will *always* find there sources of nature boundless, and will experience no difficulty in giving us new and pleasing combinations of the beautiful, without outraging the very laws by which Nature herself is governed.

Another of the principal causes of failure, at the present day, is to be found in the practical exclusiveness of the English artizan. He too often forgets that his particular production can only form *part* of the general effect required, either in external or interior decoration. He looks on his own work as the "be all and end all" of his endeavours; and, in attempting to impart an extraneous attraction to it, he produces what, in nine cases out of ten, is extravagant and out of place. To take the case of the paper-stainer as an instance: his whole aim and study seems to be, to produce a glittering, showy effect upon the eye of the spectator. To this end, he employs all the resources of architectural ornament, in relief and prospective, and culls bouquets of the most brilliant flowers, which he unhesitatingly places in conspicuous situations. Birds of Paradise, parrots, and monkeys are presented to us in profusion, each apparently striving to outvie the other in brilliancy and obtrusiveness. Thus the walls of a drawing-room, which, if properly managed, should *retire*, and give an idea of space, are, on the contrary, brought prominently forward, and every article enclosed by them, however beautiful it may be, is thus sacrificed to suit the paper-hanger's exclusive views. Now, if his ideas were less confined and narrow, he would at once see that the walls of a room, properly considered, form a background to the articles of furniture and people within them, and should, therefore, be treated only as such; and that any endeavour to give them undue prominence, must naturally detract from their effect, contract the size of the room, and dazzle and offend the eye of the spectator. In order to make our meaning more clear, let us suppose that a silversmith wished to exhibit an épergne, or any other handsome ornament, to advantage. According to the views of the European paper-hanger, he would begin by placing immediately behind it a large group of the most gaudy and brilliant flowers he can find, and giving them, in all, probability, a sky-blue or primrose-coloured background. The silversmith, however, is wiser than this. He is careful to admit of nothing which is calculated to obtrude itself on the eye: he knows the value of simplicity, and therefore contents himself with placing a plain surface of purple or crimson velvet behind his treasure, and, by such means—by concentrating the attention of the beholder—he enhances the intrinsic beauties of his work.

And thus it often happens, with regard to almost all the various producers, including architects, upholsterers, and general decorators, that, in consequence of each individual following out his own exclusive ideas, without reference to the plans of those with whom he ought to act in concert, he spoils the general effect, and often stultifies his own endeavours.

It thus becomes evident, that nothing can be truly beautiful, or in good taste, which is carried beyond the legitimate object for which it was orginally designed. An ornament, out of place, becomes an impertinence, often an excrescence, and is as offensive to refined taste, as it is useless and inconvenient.

There is now in the Museum of Practical Art, among the examples of "false principles," a large French scent-bottle, the handle of which is so highly decorated (?) as to render it almost incapable of being grasped. Can anything be more absurd than an attempt to make an article more beautiful, which ends in making it useless? Yet this is by no means an uncommon occurrence.

We have already seen that the hangings of a room may be so bedizened as to be made at variance with, instead of conducive to, general beauty of effect; and this arising simply from the endeavour on the part of the producer to compass more than the natural limits of mural decoration can possibly be found to admit.

A little observation of the ordinary manufactured productions around us, will tend to show how necessary and important is the exercise of due caution in this respect.

The first point for consideration must ever be simplicity of outline. This is undoubtedly one of the most important elements of beauty, and should never for a moment be lost sight of by the decorative artist. By simplicity of outline, we do not mean mere plainness or evenness of surface any more than meagreness of form. The simplest of all lines is the straight line; but experience teaches us, that straight lines and right angles are often at variance with good taste. In the higher walks of painting and sculpture, indeed, they are generally repudiated; and almost the only instances of their being well placed occur in architectural decorations, where it is frequently necessary to repeat and carry out the leading lines of the building. And even in this case due judgment and circumspection are requisite.

Many have been the attempts to reduce beauty to its elements—to discover in what particular abstract principle its charms lie hidden; and much ingenuity has been displayed by various modern writers, from Burke and Hogarth downwards. Hogarth's celebrated "line of beauty" consisted of a gentle double curve—that is to say, a line gently bending in two opposite directions; and it is, unquestionably, the most successful definition of beauty of line, as applicable to arts and manufactures generally. To every designer of the human figure, or of flowers—to every producer of fictile articles—to all those, in short, who feel the necessity of adding grace and elegance to their several productions, the value of this beautiful line must be fully apparent.

The only simple *lines* are the straight line, and the curved line. When these become combined in any way, or repeated in different directions, they become more or less compound lines, according to the simplicity or complexity of the various combinations employed.

Simplicity of FORM may be reduced to the square, the circle, the parallelogram, the oval, and, lastly, the triangle. A single glance at these figures suffices to show, that, as each possesses its own particular qualities strongly distinguished, so each is appropriate, in its own particular degree, to certain distinct branches of art-manufacture. The square and the triangle are proper to buildings and certain articles of furniture; while the circle and oval appertain more to pottery and glass. Combinations of the two first would make a very good elevation for a house; but if appropriated by the potter, they would produce a very sorry-looking jug, and *vice versa.*

In conclusion, we repeat that every simple form has its own peculiar beauties; but it is the master-mind of the designer which must judge of the propriety of selection and adaptation to his own purposes. C.

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OUR NATIVE LANGUAGE AND AUTHORS.—No. II.

> "Where do the words of Greece and Rome excel,
> That England may not please the ear as well?
> What mighty magic's in the place or air,
> That all perfection needs must centre there?"

CHAUCER.

It is probable that the larger number of our readers, if they have any vision whatever of Chaucer's works, see nothing but cramp, obsolete words, and uncouth orthography; nor would they look on the poet with more favour, but picture to themselves a grave, stiff-mannered student sitting in a gothic apartment, surrounded with heavy folios, wearing a long monkish dress, with a cap on his head, and untrimmed beard on his chin, his whole external appearance corresponding to the stiff and awkward lines they believe he wrote. But rein your imagination, gentle reader, on this one point, and take a lesson from nature. Remember the last sprig of sweet-briar you have plucked, and forget not that the leaf yielded not its full fragrance until pressed; or the last hazel-nut you pulled from the clustering hedge, and bethink you that the sweet kernel was not tasted till a hard shell was broken—and trust me, the pressure of the leaves of Chaucer's works, or the penetrating any rough shell you may find, will be rewarded with sweetness as fresh as that of the briar,—with food pleasant to the taste as the hazel-nut. And first for a short sketch of his life. The biographies of him are various, and the accounts inconsistent with each other; but we have taken pains to place before our readers such circumstances as appear trustworthy.

Chaucer was born in London in 1328, the 2nd year of the long and glorious reign of Edward III. The station in life of his family is not certain—the name was not at that period an uncommon one; it signifies *shacs* (or shoemaker), as is proved by a translation of St. Mark's Gospel of that date, where at ch. v. the latchet of whose shoes is expressed, "the thwange of whose *chaucers*." Yet this is no proof that the family were in trade. The name appears on the roll of Battle Abbey as that of a knight who came over with William the Conqueror; *a la Chausir* is mentioned in the Tower Records of King John's reign, and in that of Edward. A legal question concerning £1000 (a large sum in those days) was raised by a John Chaucer. As to our poet, it is believed that his birth was gentle, and it is certain that his education was what we should call liberal, since he studied at Cambridge and afterwards at Oxford. It is believed that his poem the "Court of Love," was composed at the former University, and his "Troilus and Cressido" at the latter. There also he formed a friendship with the poet Gower. It is said that, after his residence at the English Universities, he went to Paris, at that time one of the most esteemed places of study in Europe; and afterwards he entered on the study of the law in the Temple. We may be sure he was not always idle; but the only remaining record of this period of his life is of an action which we do not recommend as an example—the beating a Franciscan friar in the street, for which misdemeanour he was fined two or five shillings.

It is not known when he first attracted the notice of John of Gaunt, his earliest patron, the sixth son of Edward III., but the intimacy was contracted in youth, and lasted through life. It is not impossible that the name by which Chaucer distinguished himself at Cambridge may have an allusion to the friendship, the patromymic of the royal family being, as is well known, derived from the *Planta-genet* or broom, and *Philo-genet* (Chaucer's assumed appellation), meaning a lover of the broom. It is likely that the Prince would introduce him at Court, and it is said that he was honoured by the notice of the Queen Philippa, by that of the Countess of Pembroke, the King's daughter, and of the Countesses of Essex and Salisbury, distinguished ornaments of the Court—above all by the friendship of Blanché, first wife to John of Gaunt, at whose request he wrote the "Priere de notre Dame," and in allusion to whom, the "Complaint of the Black Knight," in "Chaucer's Dream," were composed. A still stronger attraction bound him to the Court; the charms of Philippa Pycard, or Ronet, one of the maids of honour, captivated his heart, and for nine years of courtship he proved his constancy. It is said, but it does not appear certain, that he accompanied the King to France in the year 1359, and that he was taken prisoner in a skirmish. At what time he was appointed page to the king is not recorded, but in 1367, when he was 39 years of age, we find a grant of twenty marks per annum made to him, in which he is styled "*Valettas noster.*" Five years subsequently he acquired the rank of *scutifer* or *squire.* By these last titles let no one form a picture of valet or squire of the present day. The latter was the shield-bearer of the knight, and in this capacity Chaucer was probably attached to the king's person; the former was the position occupied at their entrance into life by most of the noble or gentle youths of the day, who were placed in other families or at Court, as in schools where they might gain a due knowledge of the rules required by etiquette, and the habits of chivalry.

In 1372, Chaucer was appointed envoy, with two others, to Genoa; for what purpose is not explained, therefore the imagination may take its flight, and those who love splendour may fancy him present in the brilliant Court on the occasion of the nuptials of Violante, daughter to the Duke of Milan, with the Duke of Clarence. Those whose taste would lead them to literary retirement may suppose that he passed much time in pleasant converse with Boccacio and Petrarch (he refers to his acqaintance with the latter in his "Canterbury Tales," as one from whom he learnt the story of the patient Griselda); or if the ornamental be rejected and the utilitarian preferred, it may be imagined (as it is by Mr. Ellis), that the poet's mission may have related to some pecuniary or commercial transaction.

Soon after his return to England the king conferred on him the guardianship of Sir Edward Staplegate, for which he received a sum of £104; and about the same time was appointed comptroller of some of the Customs of the port of London, with the stipulation that the duties of the office should be performed in person, and the accounts written with his own hand. He is described as sitting regularly "reckoning accounts." Let none then fancy that a taste for idleness or irregularity in power of exertion is a necessary accompaniment of poetical genius, when the father of English verse was content, and not from pecuniary necessity, to perform the duties of a clerk. We hear of other grants of money made to him, and he alludes to a time when he was wealthy in his "Testament of Love," saying, "I had comfort to be in that plight, that both profit were to me and my friends;" thus inferring unconsciously that he was not a selfish receiver of bounty. We wish we could entertain our readers with an authentic account of his domestic felicity with the lady whom he had courted so long. It is not too much to assume it as probable, since his attachment was undoubted, and Philippa, it is believed, delayed the marriage not from indifference, but to enable her to give affectionate attendance on the Queen during her declining health; and it was not long after the death of their noble and royal benefactress that they were united. The only son named by Chaucer himself is Lewis, but there is a Thomas Chaucer, who is supposed to be his son, by some authors.

Chaucer's favour at Court did not decline during the reign of Edward III. In the last year of it he was sent with the embassy to France, to negotiate the marriage of the young Prince of Wales with a daughter of the French king.

There is a tradition that his home was a lodge in the royal park of Woodstock, and that he resided there during the early years of Richard II.'s reign, and that there he wrote the poem by which he is most generally known, his "Canterbury Tales." At the request of the Queen, Anne of Bohemia, he wrote his poem "The Legend of Good Women." Almost his earliest work was Troilus and Cressida," the heroine of which is represented as changeable in love, and it was thought by the royal lady that some atonement was required for the insult offered to the whole sex in the character of the faithless Cressida. Chaucer accordingly relates the history of several ladies, the only merit of some being constancy. He touches with great humour on the fickleness of men, and ends one of the legends with this piece of mock-advice:—

"Beware ye women of your subtle foe,
(Since yet this day men may example see),
And trust in love no other man but me."

[The last line is changed to make the words modern, but the sense is the same.]

During the turmoils and intrigues which disturbed the weak reign of Richard II., Chaucer became involved in difficulties, and at one time was obliged to leave the country. The particulars are not at all known; but after a period of adversity, we find the influence of John of Gaunt used in behalf of his friend; his pension of twenty marks was restored, and a renewal of the annual gift of a pipe of wine. He was also appointed clerk of the works at Westminster and Windsor. The Castle of Dunington in Berkshire was given to him by his unchanging friend, John of Gaunt. Here he is said to have passed most of the latter years of his life, and to have written some-poems under an oak in the park. All is changed now; farms and villas occupy the sites of sylvan glades or retired walks. The gateway and tower of the castle are the only remains of the dwelling.

Chaucer died in London in the 2nd year of Henry IV.'s reign, in a house which he rented of the Dean and Chapter of Westminster, and which was afterwards removed to make way for Henry VII.'s chapel. He was buried in Westminster Abbey.

Notwithstanding the introduction of some obsolete words, the language of Chaucer is the same as our own. The most important difference is in the form of the verb, which at that period almost universally preserved the Saxon inflection (still retained in the German language); the infinitive mood ending in *n* or *en*; also the plural of the first person, and sometimes the third person, sing thus, "*I woulde goen*," for, *I would go*; "he freely mighten gon," for, *he might freely go*; "*sooth to sayen*," for, *to say truth*.

The differences in the pronounciation are most commonly in the lengthening of the words, as by sounding the final *e* in *faire*, *smoothe*, &c., the addition of a syllable to form the plural, as *birdis*, *herbis*; and the insertion of *y* before some verbs, as y-cast; it might seem that we pronounce our words more quickly, and with less measured deliberation than our ancestors. It may be well to consider whether, if our thoughts flow more quickly too, they are not less deep and earnest.

We recommend to those unacquainted with old English, that they should read the lines aloud, and they will find many difficulties presented by the unusual spelling to the *sight* will be removed by the sound. The final *e* should often be pronounced as another syllable. This was the custom in Chaucer's time.

We extract the following beautiful description of his morning walk from the "Complaint of the Black Knight," in which a modern word is occasionally substituted, and the original one placed in a note.

"I rose anon, and thought I woulde goen
Into the wood to hear the birdis sing,
When that the misty vapour was agone,
And clear and faire was the morrowing;
The dew also like silver in shining,
Upon the leaves, as any *balme*[*] sweet;
Till fiery Titan, with his percant heat,
Had dried up the lusty liquor new,
Upon the herbis in the greene mead;
And that the flowers of many diverse hue,
Upon their stalkis *budded forth*[*] and spread,
And for to 'splay out their leavis in breadth (brede),
Against the sun, gold-burnished[†] in his sphere,
That down to them y-cast his beamis clere.
And by a river forth I 'gan *my way*,[‡]
Of water clear as breyl or crystal,
Till, at the last, I found a little way
Toward a park, enclosed with a wall,
In compass round, and by a gate small;
And in I went, to hear the birdis song,
Which on the branches, both in plain and vale,
So loud y-sang, that all the wood y-rong,
Like as it should shiver in pieces small;
And as me thoughten that the nightingale
With so great might her voice began out wrest
As though for love her heart would burst her breast.[§]
The soil was plain and smooth, and wonder soft.
All overspread with carpets[‖] that nature
Had made herself; covered eke aloft
With boughis of green, the flowers for to cure,
That in their beauty they may long endure,
From all assault of Phoebus' fervent fire (fere),
Which in his sphere so hot y-shone and clear.
The air was temperate,[¶] and the smoothe wind
Of Zephyrus, among the blossoms white,
So wholesome was, and nourishing in kind.[**]
The small buddis, and round blossoms bright,[††]
In manner 'gan of her breath to delight,
To give us hope that there fruit shall y-take,
Against Autumne, ready for to shake.
There saw I growing eke the fresh hawthorne,
In motley white that so sweet doth smell;
Ash, fir, and oak, with many a young acorn,
And many a tree more than I now can tell;
And, me before, I saw a little well,
That had his course, as I could well behold,
Under a hill, with quick streamis and gold—
The gravel gold; the water pure as glass,
The bankis round the well environing,
And soft as velvet was the younge grass
That thereupon hastily came springing;
The suit of trees abouten compassing,
Their shadows cast, closing the well around,
And all the herbis growing on the ground."

It can scarcely be necessary—but to avoid possibility of mistake—we remind our readers that none of the alterations made are considered as improvements, but simply as guides to those who are unacquainted with old English.

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[*] Baume.

[*] Goin for to spread; or, began to spread.

[†] Gold burned.

[‡] Costay, to coast.

[§] Right as her heart for love would all to brest.

[‖] Tapets.

[¶] Attempré.

[**] By kind; that is, in its nature.

[††] *Lite*, meaning little.

INORGANIC CHEMISTRY.

XXXIX. COPPER.

Equivalent, 31·65. *Symbol,* Cd. *Density,* 8·895.

Copper has been in familiar use since the times of Tubal Cain, and is one of the most important metals to the wants of society. It is often found in the metallic state. The metallic copper of Lake Superior is associated with native silver; and small proportions of silver are also often alloyed with the copper. One mass from this region, now at Washington, weighs over 3,000 pounds. Its most usual ores are the *red oxide of copper* and the *copper pyrites*, or sulphuret of copper and iron. The *blue* and *green malachites*, or carbonates of copper, and several other salts of this metal, are also found in the mineral kingdom. Copper is very malleable, and is the only red metal except titanium. It fuses at 1,996°, and has a density of 8·895, which may be increased to 9·95 by hammering. It does not change in dry air, but in moist air becomes covered with a green coat of carbonate. It is stiffened by hammering or rolling, and softened again by heating and quenching in water. It may be drawn into very fine wire, which is an excellent conductor of heat and electricity, and is much used in electro-magnetism, and for the telegraphic conductors.

Nitric acid is the proper solvent of copper, sulphuric and hydrochloric acids scarcely acting upon it. It forms two oxides, the protoxide and the suboxide.

The first, or *Black Oxide* of copper, CuO, is the base of all the blue and green salts of copper. It is formed by decomposing the nitrate with heat. It is black and very dense, quite soluble in acids, and forms many important salts, which are isomorphous with those of magnesia. It yields all its oxygen to organic matters at a red heat, and for this purpose is much used in their analysis.

The *Suboxide* or *Red Oxide of Copper,* $Cu_2\,O$, is found native in beautiful octahedral crystals, and is also formed when copper is oxidized by heat. This oxide communicates to glass a magnificent ruby-red colour. The chlorides and iodides of copper are of no great importance.

Sulphate of Copper *Blue Vitriol,* $CuO\,SO_3+5HO$, is an important salt, crystallizing in large beautiful blue rhombs, which are soluble in four parts of cold, and two parts of hot water. It loses its water by a gentle heat, and falls to a white powder. It is much used in dying, and for exciting galvanic batteries. With ammonia it forms a dark blue crystallizable compound.

Nitrate of Copper, $CuO,\ NO_5+3HO$, is formed by dissolving copper in nitric acid to saturation, and is a deep blue crystallizable, deliquescent salt, very corrosive, and easily decomposed.

CLASS V.—METALS WHOSE OXIDES ARE WEAK BASES OR ACIDS.

XL. VANADIUM. **XLI. TUNGSTEN.**
XLII. MOLYBDENUM. **XLIII. COLUMBIUM.**
XLIV. TITANIUM.

The first five metals of this class are so rare that we shall dwell on them very briefly.

(40). *Vanadium* is described as a very infusible, brittle, white metal, and dissolved only by aqua regia, affording a blue solution. It is found only in one or two very rare minerals, as in the *vanadinite,* or vanadiate of lead, acting the part of an acid. It appears to be closely allied to chromium.

(41). *Tungsten,** so named in allusion to its great weight, is found as tungstic acid in two or three rare minerals, viz., *wolfram* and *tungstate of lime.* Metallic tungsten resembles vanadium in physical characters, but it takes fire when heated in air in a state of division. It has a density of 17·4.

There are two oxides of tungsten: the first (WO_2) forms no salts; the second, *tungstic acid* (WO_3), is a yellow powder, insoluble in water, but is easily dissolved in ammonia.

(42). *Molybdenum.*—Sulphuret of molybdenum is a rather common mineral, found in soft scales resembling graphite. The metal is obtained from its oxide, and is very infusible, white, and brittle, having a density of 8·6.

It forms three oxides, MO, MO_2, MO_3, of which the last only has much importance. It resembles tungstic acid in being soluble in alkalies. It forms a beautiful yellow salt with lead, which is found native. The native sulphuret may be converted into impure molybdic acid by heat.

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* Swedish, *tungsten*, heavy stone.

(43). *Columbium,* or *Tantalum.* — This metal was named after America by Mr. Hatchett, its discoverer, who found it among some ores sent to the Royal Society in London, by Gov. Winthrop, from Connecticut.

(44). *Titanium.*—This metal is found crystallized in small brilliant cubes of a copper-red colour in the slags of some iron furnaces. Its oxide, beautifully crystallized, is well known to mineralogists, as *rutile, anatase,* and *Brookite,* three minerals specifically distinct, but chemically identical. Titaniferous iron ore is also an abundant mineral.

XLV. TIN.

Equivalent, 58·82. *Symbol,* Sn (*Stannum*).
Density, 7·29.

Tin is one of those metals which have been known from the most remote antiquity. The mines of Cornwall have been worked for the oxide of tin since the times of the Greeks and Phœnicians. Tin is a white metal with a brilliant lustre, not easily tarnished, and resisting the action of acids to a remarkable degree. It is soft, very ductile, laminable, and malleable. *Tin foil* is made of one-thousandth of an inch in thickness, or even much thinner. A bar of tin when bent gives a peculiar crackling sound, from the disturbance of its crystalline structure, familiarly called the *cry of tin.* It is one of the best conductors of heat and electricity.

Tin has a density of 7·29, and fuses at 442°. Its alloys are very valuable; gun-metal (copper 90, tin 10) is one of the strongest alloys known, of a reddish-yellow; bell-metal (copper 78, tin 22) is a very sonorous and brittle alloy, of a pale yellow; and speculum metal (copper 70 to 75, and tin 25 to 30) is a brilliant, almost white, and excessively brittle alloy. Pewter is a mixture of tin and antimony or lead. *Tin-plate* is only sheet-iron coated with tin.

Strong nitric acid does not dissolve tin, but the addition of a little water to the acid causes a violent action, and the tin is speedily oxidized.

There are three oxides of tin: the protoxide, SnO; the sesquioxide, Sn_2O_3; and the peroxide, SnO_2. (1). This is obtained by precipitating a solution of protochloride of tin with an alkaline carbonate, which yield a bulky hydrate of the protoxide. It is a very unstable compound, passing into the peroxide at a very moderate heat. (2). *The sesquioxide* is a grayish powder, which has been but little examined. (3). *The peroxide* is found native in the beautiful crystallized tin stone. It may be obtained in a soluble, and an insoluble condition. When the prochloride is precipitated by an alkali, the bulky white precipitate of hydrated peroxide which appears, is easily soluble in acids; but if tin is acted on by an excess of moderately strong nitric acid, a white insoluble powder is formed, which is not acted on by the strongest acids. Heat converts both into a lemon-yellow powder, which dissolves in alkalies, but not in acids, and which is known as *stannic acid;* it reddens test-paper, and forms salts. The *putty* used to polish stone and glass is the peroxide of tin.

XLVI. BISMUTH.

Equivalent, 70·95. *Symbol,* Bi. *Density,* 9·82.

Bismuth is found native, and also in combination with other substances. It is a brittle, highly crystalline metal, of a reddish white colour, with a density of 9·82, and fuses at 497°. It is obtained in large and beautiful cubical crystals, by perforating the crust of a mass which is just cooling from a state of fusion in a crucible, and pouring out the still fluid interior. The vessel will be lined with a multitude of brilliant crystals.

It dissolves in nitric acid, but, like other metals of this class, does not decompose water under any circumstances.

Two oxides of bismuth are known. The protoxide (BiO) is formed by gently igniting the subnitrate, and is a yellowish powder, easily soluble in acids, and is the base of all the salts of bismuth. It is, however, a very feeble base, since even water decomposes its salts. The peroxide (Bi_2O_3) is not of much interest.

XLVII. ANTIMONY.

Equivalent, 129·04. *Symbol,* Sb (*Stibium*).
Density, 6·7.

This metal is derived chiefly from its native sulphuret, which is a rather abundant mineral. The metal is obtained by fusing the sulphuret with iron-filings of carbonate of potash, which combines with the sulphur and sets free the metal. It is a white brilliant metal with a blue tint, forming broad rhomboidal crystalline plates. It is very brittle, and like bismuth may be reduced to a fine powder. It fuses at about 1,000°, or low redness, and at a higher heat is volatilized. It dissolves in hot hydrochloric acid, but nitric acid converts it into the insoluble white antimonic acid.

Its alloy with lead is type-metal, which, like the alloys of bismuth, gives very sharp casts. By reason of the expansion from crystallization it suffers in solidifying, although it is remarkable that both of the constituent metals shrink when cast separately. Finely powdered antimony is inflamed in chlorine gas, forming the perchloride.

Three compounds of antimony and oxygen are known, viz.:—

(1). *Oxide of Antimony,* SbO_3.—This oxide may be obtained by digesting the precipitate from chloride of antimony by water, with carbonate of potash or soda, or by burning antimony in a red-hot crucible. It is a fawn-coloured insoluble powder, anhydrous, and volatile when highly heated in a close vessel. Boiled with cream ot tartar (acid tartrate of potash), it forms the well-known *tartar emetic,* which may be obtained in crystals from the solution.

The Glass of Antimony is an impure fused oxide prepared for the purpose of making tartar emetic. Heated in air, this oxide gains another equivalent of oxygen, and forms—

(2). *Antimonious Acid,* SbO_4.—This is a gray powder, not volatile, insoluble in acids, unless recently precipitated. Its hydrate reddens litmus paper, and combines with alkalies.

(3). *Antimonic Acid,* SbO_5, is formed as already stated, when antimony is digested in an excess of strong nitric acid. It dissolves in alkalies, with which it forms definite salts, that are again decomposed by acids, hydrate of antimonic acid being thrown down. The hydrate loses its water below a red heat, becoming a crystalline fawn-coloured powder, and by a higher heat one equivalent of oxygen is expelled, antimonious acid being formed.

XLVIII. ARSENIC.

Equivalent, 75·21. *Symbol,* As. *Density,* 5·884.

Metallic Arsenic is found native in thick crusts, called testaceous arsenic, evidently deposited by sublimation. It is however more usually obtained from roasting the ores of cobalt, nickel, and iron, with which metals it is often combined, forming arseniurets. The vapours of arsenious acid given out in the roasting, are condensed in a long horizontal chimney, or in a dome constructed for the purpose; the first product being purified by a second sublimation. Arsenic is a brilliant steel-gray metal, brittle, and easily crystallized. It cannot be sublimed unchanged in presence of air, but may be so in close vessels, at a temperature of 356°, without previously melting. Its vapour has a very powerful garlic-like odour, like phosphorus. This metal is known by druggists under the absurd name of *cobalt,* and is sold in powder to destroy flies. Metallic arsenic is easily obtained by subliming the common white arsenic with black flux, in a vessel of hard glass, like a cologne vial or oil bottle. The metal forms a brilliant black crust in the upper and cooler parts of the vessel.

Arsenic forms two compounds with oxygen.

Arsenious Acid—White Arsenic—Rat's Bane, AsO_3.—This well known and fearful poison is formed as just stated, when metallic arsenic is sublimed in air, or when any of the ores of arsenic are roasted. This acid is what is usually known as *arsenic* in commerce. When newly sublimed, it is a hard transparent glass, brittle, and with a density of 3·7. It slowly changes to a white opaque enamel. As sold in commerce, it is usually reduced to a white powder, rarely found without adulteration. It sublimes at 380°, without change, and crystallizes in brilliant octahedrons, as may be well seen by heating a small quantity in a glass tube. Its vapour is inodorous, but if sublimed from charcoal it gives the peculiar garlic odour of metallic arsenic, being reduced to that state. It is soluble in about 10 parts of hot water, and is almost tasteless, with a faint sweetish flavour, which renders it the more dangerous poison, since no warning is given to the victim who takes it, as in case of most other metallic poisons. The solution in water is acid to test-paper, and deposits nearly all its arsenic in crystals, on cooling. Hydrochloric acid dissolves it, as also do alkalies, which, however, do not form crystalline salts with it. The best antidote to the poisonous effects of arsenic is the hydrated peroxide of iron, freshly precipitated, and used in its gelatinous condition.

Arsenic Acid, AsO_5.—This acid is formed by adding nitric acid to the solution of white arsenic, in hydrochloric acid, as long as any red vapours of nitrous acid show themselves, and then carefully evaporating the solution to entire dryness; a white porous slowly subcrystalline mass remains, which is soluble in water. Its solution is a powerful acid, quite similar in chemical characters to phosphoric acid. The analogy is so great that there is a complete similarity in constitution, and even in external appearance, between all the salts of these two acids. For every tribasic phosphate we have an arseniate, not only similar in constitution, but isomorphous, and so resembling it in all its external properties as not to be distinguished by the eye. Thus the tribasic phosphate of soda, and the tribasic arseniate of soda, are—

Phosphate of soda .	$PO_5,2NaOHO+24Aq.$
Arseniate of soda .	$AsO_5,2NaOHO+24Aq.$

These, and many other facts, lead to the opinion that the elements are themselves isomorphous, and in fact arsenic has no claim to the metallic character but its lustre, being in chemical properties and natural affinities associated with phosphorus.

The Chloride of Arsenic ($AsCl_3$) is a fuming volatile liquid, decomposed by water, and very poisonous. The bromide and iodide are both crystallizable solids, also decomposed by water.

The sulphurets of arsenic are natural compounds, used as pigments, and also in pyrotechny. The first, AS_2, is a red transparent body called *realgar*, and AsS_3 is the golden yellow *orpiment*. Both these substances are found native, and, as usually associated, they are brought from Koordistan in Persia, and from China. The higher sulphurets may be formed, which are AsO_5 and AsO_9; the former is the product thrown down by sulphureted hydrogen in a solution of arsenic. All but the highest of these compounds are sulphur acids.

Arseniureted Hydrogen.—This is, perhaps, the most deadly poison known. It is a gas produced by the action of dilute sulphuric acid on an alloy of zinc and arsenic, or by the evolution of hydrogen in presence of arsenic or arsenious acid. This gas is readily absorbed by a solution of sulphate of copper, and precipitates an arseniuret of that metal. It burns with a peculiar blue flame, and deposits metallic arsenic or arsenious acid. Marsh's test for arsenic depends on the generation of this gas.

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THE STUDY OF CHEMISTRY WITH THE BLOWPIPE.—No. III.

Manganese.—The experiment that we are about to explain demands attention, not only as one of the most delicate and interesting in the whole range of modern chemistry, but as illustrating the characteristics of the blowpipe flame. It has been already observed, that the internal cone of the flame is of a blueish colour, and has the chemical property of deoxidizing substances submitted to it; and that the external one is of a straw-yellow colour, and possesses the opposite property; for all substances capable of chemical union with oxygen such as the metals are almost instanteously oxidized in the apex of this cone. Hence it is that the inner is called the reducing, and the outer the oxidizing flame. Bearing these facts in mind we may proceed with the experiment.

As the end of a hooked piece of platina wire, produce a small transparent bead of borax, and place on it a minute quantity of the oxide of manganese. Expose it then to the outer cone of the blowpipe flame, till it is raised to a bright red heat. Intensely bright corruscations of light will for a time be seen floating about the bead, and when cold it will have a rich amethystine colour. This is the effect produced at the apex of the yellow or oxidizing flame, and the manganese in the bead is therefore in the state of an oxide. But now let the bead be introduced into the apex of the blue or deoxidizing flame, and when brought to a white heat, various striæ will appear on the surface of the globule. These will after a time disappear, and when cold the globule will be colourless.

Iodine.—1. If any compound containing

iodine be touched with a drop of sulphuric acid, and exposed to the blowpipe flame in a small glass tube, a violet coloured vapour will be produced, having a pungent smell. When sublimed and condensed on the sides of the tube, it is in the form of small scales having a steel colour.

2. To a small quantity of the sulphuret of mercury add a like quantity of the hydriodate of potash. If this be exposed in a glass tube to the flame of the blowpipe, a sublimate of a rich vermilion colour will be produced.

Zinc.—1. Place a fragment of zinc before the flame of the blowpipe, on a piece of charcoal, and an intensely blue flame will be produced, when it is raised to a white heat.

2. If a small piece of zinc be placed in a glass tube and heated, the white oxide of zinc will be sublimed, and adhere like wool to the sides of the glass; but upon examination it will be found to consist of separate crystals, like delicately formed minute needles.

Lead.—With this metal many beautiful experiments may be performed, showing the reduction of a metal from its oxide.

1. Put a small quantity of red lead with a little powdered charcoal, and add a few grains of the carbonate of soda. When introduced into the blue or inner flame of the blowpipe, it will for an instant appear agitated and boiling, but when this action has subsided a globule of pure lead will be found on the charcoal.

2. Remove the globule of lead, formed by the last experiment, to another part of the charcoal, and expose it to the outer or yellow flame. When fused, a yellow ring bordered by one of red, will be observed on the charcoal, occasioned by the reproduction of the oxide of lead.

Tin.—Tin is one of the most oxidizable of the metals, and many experiments may be made with it.

1. If a few grains of this metal be introduced into the yellow cone of the flame, they will soon be converted into a white powder.

2. Place a small portion of the white powder produced in the last experiment upon a bead of borax, and heat it in the blowpipe flame upon a hook of platina wire. By this process it will become opaline, and refract the red rays like opal itself.

3. The remaining portion of the white oxide of tin, produced by the first experiment, may be placed in a small cavity formed on charcoal and exposed to the blue or deoxidizing flame, and it will be again reduced into a globule of pure tin.

Iron.—1. To a minute portion of iron add a small quantity of the carbonate of soda, and bring them to a red heat; when perfectly fused they form a mass of a black or dull brick red colour. To apply this experiment, take a few pieces of the golden coloured scales frequently seen in coal, and fuse them with soda: the effect already described will be produced, proving that iron is present. Now put a drop of sulphuric acid on the fused mass, and a vapour will be emitted, at once detected by its fœtid smell as sulphuretted hydrogen, and proving the component parts of the mineral to be sulphur and iron.

Copper.—Take a little arseniate of copper, and mix it with carbonate of soda and powdered charcoal. Bring these substances to a white heat, and, when all chemical action has ceased on the surface, a metallic globule of copper will be found which presents a metallic brightness, and may be flattened by a blow with a hammer.

2. Take any mineral containing copper, and place a small portion of it powdered, on a transparent bead of fused borax. Raise it to a white heat in the yellow flame, and the glass will be tinged with an emerald green colour.

Gold.—This metal cannot be oxidized in the flame of the blowpipe; but if any preparation of gold be exposed with boracic acid to an intense heat, a globule of a delicate rose or violet colour will be produced. This is occasioned by the glass being tinged with the oxide of gold formed during the operation. The delicate rose tints produced on porcelain are obtained by combinations of the oxide of gold.

We may now proceed to examine a few of the phenomena resulting from the action of heat on some of the simple compounds, both alone and with fluxes. This will be best done by taking first the acids, then the alkalies and alkaline earths, the earths, and lastly the metallic oxides.

TO DETECT THE PRESENCE OF THE ACIDS.

Sulphuric acid is detected by fusing silica and soda into a globule, and then, having placed the assay upon the globule, heating them together in the flame of the blowpipe. In this operation the sulphuric acid is reduced, and the sulphuret of soda is formed. The glass immediately assumes a dark brown tint; or it becomes colourless during fusion, and red or orange in cooling, according to the quantity of the salt operated upon.

The Nitrates, if fusible, detonate with charcoal; when they are infusible, they must be heated to redness in a tube closed at one end. Nitrous gas is then given off, and meeting the oxygen of the atmosphere is converted into nitrous acid gas, which is exhibited as an orange-coloured vapour.

Muriatic acid.—For the detection of this acid, oxide of copper is to be fused with salt of phosphorus into a dark green globule; the assay is then added. If muriatic acid be present, the globule is surrounded by a fine blue flame approaching to purple, during the application of heat, which continues as long as any muriatic acid is given off by the assay.

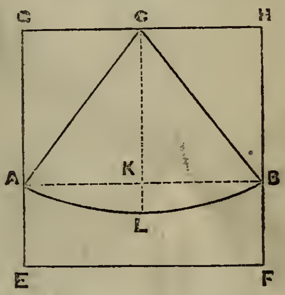
Phosphoric acid is detected by fusing the assay with boracic acid. The globule is removed from the charcoal on which it is melted by inserting the end of a fine wire in it, and then heated in a good reducing flame. If the assay contains phosphoric acid, the iron is oxidated at the expense of the acid, and a borate of protoxide and phosphuret of iron is the result. The latter fuses at a high temperature, and the assay which previously spread over the length of the wire, contracts and resumes the globular form. As the globule cools, an appearance of ignition is observed near the base, arising from the crystallization of the phosphuret, which forms a brittle metallic globule of a steel coloured fracture, and is attracted by the magnet. If the assay contain no phosphoric acid, the steel wire will burn only at the ends which project beyond the globule, preserving elsewhere its form and brilliancy.

TO DETECT THE PRESENCE OF THE ALKALIES.

The alkalies do not give any sufficiently marked characteristics under the action of the blowpipe. Pure or carbonated they redden turmeric, and discharge the red colour given to litmus paper by an acid. Ammonia may be recognised by the pungent smell it evolves when heated with caustic potass. Potass and soda, whether pure or carbonated, unite with silica under the blowpipe, and produce a transparent glass globule. When the alkali is added in slight excess, there is a trifling deliquescence, if it be potass, but no such effect is observed if it be soda; yet these characters are not sufficient in every instance to distinguish the alkalies.

ANSWER TO A QUERY

IN PAGE 219, No. 69.



Let A B C denote the sector whose area is required; then E A = F B = 5; E F = A B = 12; E G = F H = 13; G C = C H = 6; and A G = E G — E A = 13 — 5 = 8.

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Then  8          6
      8          6
     ——         ——
     64         36
     36
   ————
    100(10 = A C = B C, the length of the
    1        string, or the radius of the sector.
   ————
    ·00
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Also K C = A G = 8.

Hence, L C — K C = 10 — 8 = 2, the versed line K L.

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                      2              2
Then 20              41              2
                    ———             ——
      1·64       50)82·            3)4
     —————       ——————           ————
     18·36         16·4            1·33
18·36)1·3333(·072621              1·
      1·2852                       ·072621   A L B
     ———————                      ————————
      · 4813                      1·072621   of the area
       3672                             12
     ———————                      ————————
       11413                     12·871452   ft. length
       11016                             5
     ———————                      ————————
      · · 3973                   64·357260 ft. area of the
          3672                              sector required.
       ———————
         · 3013
           1836
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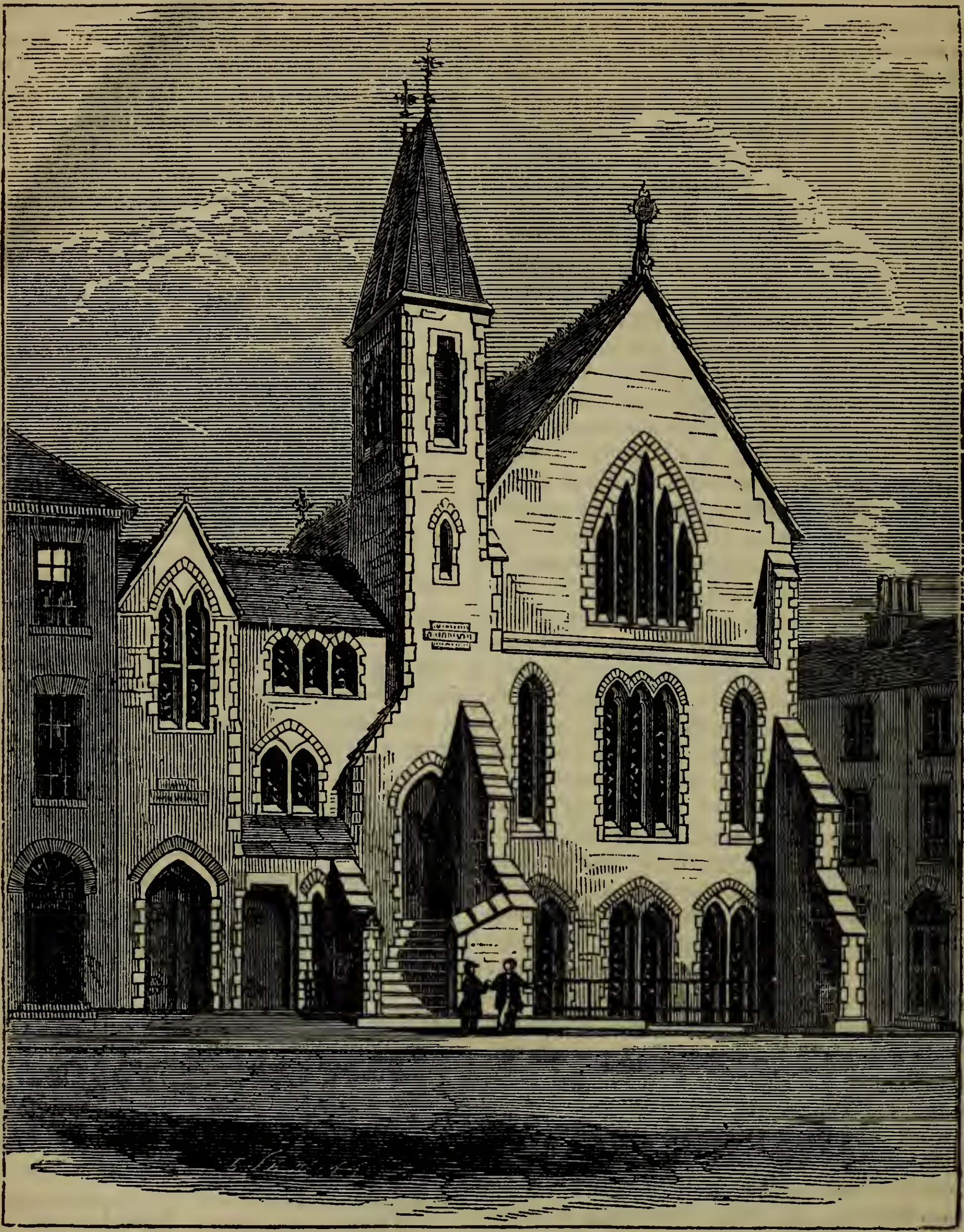

ST. AUGUSTINE'S SCHOOLS, LIVERPOOL.

PUBLIC SCHOOLS.

ST. AUGUSTINE'S SCHOOLS, LIVERPOOL.

We are happy to perceive that the progress of education, in this great commercial capital of England, is coeval with her prosperity and general wealth. We have already noticed some of her public places of education, and we have now to direct the attention of our readers to St. Augustine's Schools, recently erected in Salisbury-street, which occupy an area of twenty yards in front, and thirty-seven yards deep.

In the general architecture of the building there is a dignified simplicity which cannot fail to produce a pleasing effect on the mind of the spectator. Its general character is early English, numerous specimens of which appear in our conventual buildings of that period. The front to Salisbury-street is the principal one; it displays a bold gable, flanked by buttresses, and pierced by the eastern windows of the schools; those of the infant school being six lights, in pairs; those of the boys' five (a triplet in the centre, and a single light at each side); and the girls' an arrangement of five lights combined, rising into the gable. The approach to the boys' school is by an external stair, and above it rises a turret, oblong on plan, surmounted by an acute leaded roof, crested with cruciform ornaments in gilt metal. The materials of the front are Upholland wall stone and white Runcorn stone dressings, the remainder of the building being of brick, with red stone dressings. All the bearing timber is of Baltic growth.

The edifice consists of a principal or main body, lying on the northern part of the site, and two wings; the chief building containing the schools, the infants' on the ground-floor, the boys' on the first, and the girls' on the second floor, each about 65 feet by 28 feet: the land falling from east to west, the infant-school is partially sunk on the Salisbury-street side, and the ascent to the other two schools is proportionably diminished. The infant-school is 15 feet high, the boys' 16 feet, and the girls' 11 feet to the wall-plate, and 30 feet to the ridge. Of the wings, which project southwardly from the schools, the front one contains the approaches and cloak-rooms, and the back or western wing the class-rooms and a committee-room; the intermediate space, which is bounded southwardly by other buildings, forming the girls' yard; those for the boys and infants lying westward of the schools and class-room wing, next Back Salisbury-street. The infants' and boys' class-rooms are each 24½ feet by 23 feet, and the committee-room the same, occupying a *mezzanine* between the boys' and girls' class-rooms, the last-named being 24½ feet by 27½ feet. There is accommodation, without over-crowding, for about 900 or 1,000 children.

The architect is Mr. H. P. Horner, and the work was contracted for by Mr. James Burroughs, for the sum of £2,800. The first stone was laid on the 18th of May, 1852, and the schools were opened on the 18th of April, 1853.

They were visited in the month of September by Mr. Kennedy, the Government inspector for the district, who expressed entire satisfaction with the arrangements.

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PRACTICAL ESSAYS ON EDUCATION.

ADVANTAGES OF EXERCISE.

The premature exertion of intellect to which children are sometimes stimulated by the excitement of emulation and vanity, far from strengthening, tends to impair the health and tone of the brain, and of all the organs depending on it; and hence we rarely perceive "the genius of the school" manifesting in future years any of the superiority which attracted attention in early life; but we find him, on the contrary, either sunk below mediocrity, or dragging out a painful existence, the victim of indigestion and melancholy.

On the other hand, some of the most distinguished men who have ever lived were in childhood remarkable only for health, idleness, and apparent stupidity. Sir Isaac Newton was, by his own account, an idle and inattentive boy, and "very low in the school," till he reached twelve years of age. Adam Clarke was considered "a grievous dunce" when a boy, and was seldom praised by his father, except for his ability in *rolling large stones,* which his robust frame and good health enabled him to do. Shakspeare, Gibbon, Byron, Scott, and Davy, were, in like manner, undistinguished for precocious genius, and fortunately were allowed to indulge largely in those wholesome bodily exercises, and that freedom of mind, which contributed so much to their future excellence. The mother of Sheridan, too, long regarded him as "the dullest and most hopeless of her sons."

Among the many who give great promise in early life, and whose talents are then forced by ill-judged cultivation into precocious maturity, how few live to manhood to reap the reward of their exertions, and how few of those who survive preserve their superiority unimpaired!

Tasso was early distinguished, and wrote his immortal epic at twenty-two years of age; but his life was miserable, and his reason disordered, and he died at fifty-one.

Pascal is another example of the same result; and Kirke White, and many others, might be named, were it necessary.

Experience, indeed, amply demonstrates that precocious and excessive activity of intellect and vivacity of feeling are most powerful impediments to a healthy state of the body. In early life, therefore, when not only health but future usefulness depend mainly on the completeness and vigour with which the system is developed, the preservation of the digestive organs by suitable diet, exercise, and regimen, ought to be a primary object of attention with every sensible director of youth. Even as regards superiority of mind, the healthy development of the body is of essential importance, as the only sure foundation on which mental excellence can be built; because, so long as mind and body are intimately connected with each other, the former must continue to be affected by every change in the condition of the organs on which it depends.

Different kinds of exercise suit different constitutions. The object, of course, is to employ all the muscles of the body, and to strengthen those especially which are too weak; and hence exercise ought to be often varied, and always adapted to the peculiarities of individuals. Speaking generally, *walking* agrees well with everybody; but, as it exercises chiefly the lower limbs and the muscles of the loins, and affords little scope for the play of the arms and muscles of the chest, it is insufficient, of itself, to constitute adequate exercise; and hence the advantage of combining with it movements performed by the upper part of the body. Nature, indeed, has shown her intention that the upper part of the body should always partake in the exercise of the lower, by rendering it impossible for us even to walk gracefully without the arms keeping time, as it were, with the movements of the legs.

Pedestrian excursions in pursuit of mineralogical or botanical specimens, combine in their results all the advantages which well-conducted exercise is capable of yielding, and are much resorted to in the German seminaries for the purpose of developing the mental and bodily powers.

Exercise, however, must always be proportioned in extent to the constitution and previous habits. Even a single day of excessive fatigue will sometimes suffice to interrupt growth, and produce permanent ill-health.

Dancing is a cheerful and useful exercise, but has the disadvantage of being used within doors, in confined air, often in dusty rooms, and sometimes at unreasonable hours.

Many of the common *gymnastic and calisthenic exercises* are fit only for robust and healthy boys; they are not at all fit for improving those who are delicately constituted, and who stand most in need of a well-planned training.

For giving strength to the chest, *fencing* is a good exercise for boys; but the lesson should never be measured by the hand of the clock, but by its effects on the constitution.

Shuttlecock, as an exercise which calls into play the muscles of the chest, trunk, and arms, is very beneficial. It should, if possible, always be played in the open air. After a little practice, it can be played with the left as easily as with the right hand; and is therefore very useful in preventing curvature, and giving vigour to the spine in girls. It is an excellent plan to play with a battledore in each hand, and to strike with them alternately.

Dumb-bells, when they are not too heavy, and the various movements gone through not too eccentric or difficult, are very useful.

When any of these exercises are resorted to in the house, the windows should be thrown open, so as to make the nearest possible approach to the external air.

Reading aloud and recitation are useful and invigorating muscular exercises, when managed with due regard to the natural powers of the individual, so as to avoid effort and fatigue. To the invigorating effects of this kind of exercise, Cuvier was in the habit of ascribing his own exemption from consumption, to which, at the time he was appointed to a professorship, it was believed he would otherwise have fallen a victim.

It appears, then, that the most perfect of all exercises are those sports which combine free play of all the muscles of the body, mental excitement, and the unrestrained use of the voice. To such sports, accordingly, are the young so instinctively addicted, that nothing but the strictest vigilance, and fear of punishment, can deter them from engaging in them the moment the restraint of school is at an end.

Many parents, and some teachers, I am sorry to add, forgetful of their own former experience, and ignorant that such are the benevolent dictates of Nature, abhor these wholesome outpourings of the juvenile voice, and lay restrictions upon the children under their charge, which, by preventing the full development of the lungs and muscles, inflict permanent injury upon them.

"If, as regards exercise," says Mr. South, "a girl is to have fair play, and if her parents desire she should be a well-formed and healthy woman, she must be allowed till at least ten or twelve years of age the same freedom from restraint, and to exercise her limbs, as freely as boys do. . . They should be allowed to run about freely; they should use a skipping-rope, trundle a light wooden hoop,—taking care, however, the stick with which they drive it changes hands, so that the muscles on each side of the body be equally exercised; otherwise the spine will curve towards the most used, or the alone used side. They should be encouraged to play at battledore and shuttlecock, or trap-bat, and throw light balls. By one or other of these means, plenty of proper exercise may be undergone. . . . When the child is tired she should be allowed to sit down, not in one of those horrible narrow-bottomed, straight high-backed chairs, but on a low chair, in which she can sit comfortably, and against which she can lean, and change her posture at pleasure."

I quote Mr. Erasmus Wilson on a very important topic, as connected with exercise. "What," asks that clever writer—"what is it that makes the difference between the exercise of youth and that of the felon on the tread-wheel; between the pedestrian in the Isle of Wight or Switzerland, and the pedestrian from Chelsea to the Bank; between the light and quick footstep wending to Greenwich Park, and the dull tread of the nursery-maid at home? Is it not mind? Is it not the young and buoyant joy of the schoolboy that inspirits his laugh and his leap? While, silent and morose, humiliated, not convinced, the felon suffers his monotonous existence,—moving, it is true, but not in exercise. Is it not the novelty or the beauty of the scene, the pleasant weather, or the immunity from customary labour, that gives spirit to the pedestrian tour, as compared with the dull, desultory repetition of the same sights, same persons, same things, and same path from and to business? Is it not the prospect of enjoyment, of gaiety, or pleasure, that makes the difference between the elastic step of the maiden, enfranchised from present duties, and the same person in the pursuit of her necessity-impelled and ordinary offices? We need not ask which is most calculated to be beneficial to health—which to increase the vigour of the frame, purify the complexion, and enrich the beaming tints of beauty. In *mind* lies the great secret of beneficial exercise, and, without it, exercise is a misnomer and a fraud upon the constitution."

But enough has been said to enable any rational parent or teacher to determine the fitness of the different kinds of muscular exercise, and to adapt the manner and degree of each to every individual under his care.

With regard to the *time* at which exercise ought to be taken, I may state that those who are in perfect health may engage in it at almost any hour, except immediately before and after a full meal; but those who are not robust, ought to confine their hours of exercise within narrower limits.

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STATE OF EDUCATION AMONG THE NATIONS OF ANTIQUITY.

It has often formed a subject of elaborate discussion among the learned, whether education, in the early ages of antiquity, was so generally diffused amongst the mass of the population, as the classical student might be led to infer, from the many brilliant emanations of the human mind which have been transmitted to modern times. Writers without readers would have been useless; and it is fair to presume that at the periods of Homer and Herodotus,—of Pausanias, of Pliny, and of Virgil,—education was generally diffused; and the works of these celebrated writers duly appreciated by the multitude. Indeed we shall find, on taking a general review of the subject, that even among the very earliest nations of antiquity, especially the Cretans, Persians, Greeks, Spartans, and Romans, the education of the people, both mentally and corporeally, was considered of the highest importance to the State, and looked upon as absolutely necessary to their political existence and social well-being. It indeed strikingly illustrates the fact, that according as the education of youth was promoted, so did the nations of antiquity stand pre-eminent; and in proportion as that education was neglected, they sank in political consequence and national superiority, until they eventually became merged in the semi-barbarism from which they aboriginally sprang.

To commence with one of the earliest nations of antiquity,—we find that, among the ancient Cretans, their celebrated law-giver Minos was extremely rigid in enforcing the education of youth. He decreed that the children should be all brought up and educated together, by troops and bands; in order that they might learn early the same principles and maxims. Their life was hard and sober. They were accustomed to be satisfied with little, to suffer heat and cold, to walk over steep and rugged places, to skirmish with each other in small parties, to suffer courageously the blows they received, and to exercise themselves in a kind of dance in which they carried arms in their hands, and which was afterwards called the Pyrrhic; in order, says Strabo, that, even to their very diversions, everything might form them for war. They were also made to learn certain airs of music, but of a manly, martial kind. They were not taught either to ride or to wear heavy armour; but, in return, they were made to excel in drawing the bow, which was their most usual exercise. Among the later Cretans, the cultivation of the mind was not neglected, and care was taken to give the youth some tincture of learning. The works of Homer, of much later date than the laws of Minos, were not unknown amongst them; though they set small value upon, and made little use of, foreign poets. They were very curious in such knowledge as is proper to form the manners; and, what is no small praise, they piqued themselves upon thinking much, and speaking little. The poet Epimenides, who made a voyage to Athens in the time of Solon, and was in great estimation there, was a native of Crete, and is by some placed in the number of the seven sages.

The laws and customs of the Persians were excellent, with respect to education. The public good, the common benefit of the nation,—was the only principle and end of all their laws. The education of children was looked upon as the most important duty, and the most essential part of government. It was not left to the care of fathers and mothers, whose blind affection and fondness often render them incapable of that office; but the State took it upon themselves. Boys were all brought up in common, after one uniform manner; where everything was regulated,—the place and length of their exercises, the times of eating, the quality of their meat and drink, and their different kinds of punishment. The only food allowed either the children or young men, was bread, cresses, and water; for their design was to accustom them early to temperance and sobriety. Till sixteen or seventeen years of age, the boys remained in the class of children; and here it was they learned to draw the bow, and to fling the dart or javelin; after which they were received into the class of young men. Cyrus himself was educated in this manner, and surpassed all of his age, not only in aptness to learn, but in courage and address in executing whatever he undertook.

In Greece, the education of youth was more cultivated than in any other nation. At Athens the youth were first put under the care of grammarians, who taught them by principles, and with regularity, their own tongue, and gave them a thorough knowledge of all its energy, all its harmony, and all its beauty. Hence that refined taste which was spread through all Athens, where history informs us that a poor woman who sold herbs perceived that Theophrastus was a foreigner, by a very small impropriety in his use of a word. And hence the Athenian orators were so cautious and delicate in their choice of expressions before the most judicious people in the world. Many of their young men could repeat from beginning to end their most celebrated tragedies. It is well known, that, after the defeat of the Athanians at Syracuse, many of those who had been made prisoners, alleviated the yoke of servitude by reciting the tragedies of Euripides to their masters; who were so charmed with the fine verses of the poet, that they treated the captives who repeated them with great humanity and kindness. Doubtless they paid the same attention to the other famous Greek poets; for we learn from history, that Alcibiades, having entered a school, in which he found not a Homer, gave the master a box on the ear, deeming him an ignorant wretch, and one who disgraced his profession. As to eloquence, it is not surprising that it was studied with particular diligence at Athens. For it was eloquence which opened an avenue to the first offices of the State, which presided in assemblies, which decided the most important affairs, which gave almost a sovereign power to its possessor. It was therefore the principal object and study of the young Athenian citizens, particularly of those who aspired to the first dignities of the Commonwealth. To the study of rhetoric they joined that of philosophy. In this latter term we comprehend all the sciences which it implies in its greatest latitude. A set of men, known to antiquity by the name of Sophists, had acquired a great reputation at Athens, especially in the time of Socrates. These ancient doctors, equally presumptuous and avaricious, piqued themselves on knowledge of every kind. They particularly boasted of their skill in eloquence and philosophy, while they corrupted both, by the false principles and bad taste which they infused into their disciples. The abilities and opposition of Socrates brought their pretensions into a well-merited disrepute. The young Athenians, as well as all the other Greeks, were very attentive to acquire vigour, activity, and address of body, which they were regularly taught by the masters of the palæstræ. The places destined to these exercises were called palæstræ, or gymnasia: they were almost the same with our academies. Plato, in his Book of Laws, after having shown of what importance it was to improve the agility of the hands and feet, adds, that a well-governed commonwealth, instead of prohibiting the profession of the athletæ, should, on the contrary, propose prizes for all who excel in those exercises which tend to bring the art military to perfection. There were masters who taught the youth to ride, and the use of their arms. Others were appointed to teach them the higher branches of the military art, such as make a good commander. All the science of these masters was, however, confined to what the ancients called *tactics*, *i. e.*, the proper disposition of an army for battle, and the art of making evolutions.

Lycurgus, the Spartan legislator, looked upon the education of youth as the greatest and most important object of a legislator's care. His grand principle was, that children belonged more to the State than to their parents; and therefore he would not have them brought up according to their humours and caprice, but would have the State entrusted with the care of their education, in order to have them formed upon fixed and uniform principles, which might inspire them betimes with the love of their country and of virtue. At the age of seven years they were put into the classes, where they were brought up altogether under the same discipline. Their education, properly speaking, was only an apprenticeship of obedience. As for literature, they only learned as much as was necessary. All the sciences were banished out of their country. Their study tended only to know how to obey, to bear hardship and fatigue, and to conquer in battle. The superintendant of their education was one of the most honourable men of the city, and of the first rank and condition, who appointed over every class of boys masters of the most approved wisdom and probity. There was one kind of theft only (and that, too, more a nominal than a real one), which the boys were allowed, and even ordered to practise. They were taught to slip, as cunningly and cleverly as they could, into the gardens and public halls, in order to steal away herbs or meat; and if they were caught in the fact, they were punished for their want of dexterity. We are told that one of them, having stolen a young fox, hid it under his robe, and suffered, without uttering a complaint, the animal to gnaw into his belly, and tear out his very bowels, till he fell dead upon the spot. The intent of the legislator, in allowing theft, was to inspire the Spartan youth, who were all designed for war, with greater boldness, subtilty, and address; to inure them betimes to the life of a soldier; to teach them to live upon a little, and to be able to shift for themselves.

Among the Romans the education of youth was strictly attended to. Their minds and bodies were improved at the same time; their minds by every necessary branch of knowledge and learning, and their bodies by the manly exercises of the Campus Martius, or private contests and trials of skill, agility, and strength. It was the chief aim of the Romans to make them shine in the senate and in the field, at the forum and the public games. Oratory was an object which they kept constantly in view; and whatever was their destination, they endeavoured to acquire the arts of elocution, and a habit of fluent reasoning.

With the Celts, education was extremely defective. It does not appear that the people were acquainted with the art of writing; but they learned hymns or triads by heart, singing and dancing to music, and their exercises were entirely military. Learning was confined to the Druids. The youth among the Gauls were obliged to keep the belly within the compass of a girdle of a certain size, whence the iron girdles of the Britons mentioned by Herodian; and they were to effect this by fasting, running, riding, and swimming, and other athletic exercises; all which Giraldus mentions of the Welsh and Irish. They held it dishonourable to learn to read and write; and what they could learn from their Druids is shown by Strabo, who says that the latter, in their lectures of morality, gave this as a maxim, that the fertility of the fields depended upon the riches of themselves,—the Druids.

Among our early Anglo-Saxon ancestors we find children learning the Psalms by heart, but no instruction in reading. They appear to have been religiously brought up under their parents or masters, or in monasteries, or under bishops, who either made monks or clerks of them, or sent the adults in arms to the king. In later periods, the Saxons, among the higher orders, appear to have been educated, though to a very limited degree, in the first rudiments. Alfred remained without any tuition till twelve years old, when he was instructed in hunting, building, and psalmody. He strongly urged his nobles to the instruction of children in letters. All his children were educated in the Anglo-Saxon psalms, books, and poetry. "Æthelweard, Alfred's youngest son," says Mr. Turner, "received a sort of public education. He was committed to proper teachers, with almost all the noble children of the province, and with many of inferior rank. There they were all assiduously instructed in Latin and Saxon and writing; and, when their matured age gave the requisite strength, in hunting and gymnastics, as auxiliary to warlike habits." In the succeeding ages of papal domination and feudal despotism, usually denominated "the dark ages," education appears to have been entirely neglected throughout the Christian world; scarcely any one but the priesthood, or *clerks*, being able even to read or write: then—

> "Benighted reason slumber'd in the breast,
> Lull'd by the gloom of ignorance to rest."

until the invention of Printing, succeeded by the Reformation, effectually dispelled the mist of universal ignorance, which had brooded over Europe, and once more opened the way to education, and its consequent blessings. P. A. N.

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UNIVERSITY OF TORONTO, IN CANADA.

It is gratifying to observe the progress of education in our Canadian provinces, and that education of the highest character is receiving that encouragement which its importance deserves, both in a national and a social point of view. At a convocation lately held at the Toronto University, for the admission of students to degrees, an English essay, the subject of which was "Palmyra," was read by A. M. Clark, B. A., and a Greek poem was read by E. A. M. Crombie; and also an English poem on "Jerusalem," by H. W. Peterson. Twenty-three students were matriculated. The ceremonies and exercises were concluded by an address from the President of the University, Dr. M'Caul, in which he stated that, out of 180 matriculated students, there are 33 scholarships. The Doctor also dilated at length, and in an eloquent manner, on the advantages derivable from such an institution as the Provincial University.

Last of the months, severest of them all,
Woe to the regions where thy terrors fall;
For lo! the fiery horses of the sun
Tho' the twelve signs their rapid course have run.

Time like a serpent bites his forked tail,
And Winter on a goat bestrides the gale;
Rough blows the north wind near Arcturus' Star
And sweeps, unrein'd, across the polar bar.

According to the calendar of Romulus, this was the tenth month, as the word implies; but by the Julian calendar it was made the twelfth. Among the Romans the month was devoted to various festivals. On the 5th they kept the Faunalia; on the 17th the Saturnalia; on the 22nd, the Lararia; and on the last, the Juveniles Ludi. The peasants also kept the feast of the goddess Vacuna, after having got in the fruits and sown their corn. During this time all orders of the community were devoted to mirth and festivity. Masters and slaves were all on an equal footing. Friends sent presents to one another, and feasted together at the same table. The schools kept a vacation, and nothing was to be seen in the city but mirth and freedom.

December, dreary, unpleasant, cold, wet, and ice-bound! You may feel that it is, but we do not. We always associate merry groups of merry faces and merry hearts, collected together around a cheerful blazing yule-log, or even a coal fire—but a cheerful one,—with nice little branches of holly and mistletoe hanging in different parts of the house, particularly in the passage. In some way, that we cannot account for, visions of pretty faces will always arise at the sound of the name of December, and then we are absorbed in a kind of dreamy train of thought, in which bon-bons, polkas, soft blue or dark flashing eyes, ringlets and plain hair, muslins, velvets, silks, and satins are jumbled together in wild confusion with plum pudding, champagne, claret, good old port, head-aches, grave physicians, and the magic-lantern. Did you never experience any of these sensations, gentle reader? If you never did we trust you never will, if they are likely to prove disagreeable ; for our own part, we love December, although it is the close of the year.

Our Saxon ancestors called the month *Winter Monath*, but after their conversion to Christianity they called it *Heligh Monath*, or Holy month, in commemoration of the Nativity, which is always celebrated in this month. It was also called *guil-erra*, or the first *guil*, the feast of Thor, which was held at the winter solstice, being called *guil* from *iol*, or *ol*, which signified ale. This feast was even continued into January, and has become corrupted into *yule*.

Synonymes.—In Latin, *December* ; French *Decembre* ; Italian, *Dicembre* ; Spanish, *Dicicembre* ; and in Portuguese, *Dezembro*.

This month was represented by the ancients as an old man, with a severe and fearful countenance, clothed in a coarse frieze rug, girt upon him; his hands encased in fur gloves, and holding a hatchet, emblematical of the season, it being the time for felling timber. Instead of his head being surmounted by a garland, it appeared to be wrapped in three or four nightcaps, with a Turkish turban over them; his mouth and beard were clogged with icicles, and at his back was a bundle of ivy, holly and mistletoe, and at his side the sign of *Capricornus*, the goat, symbolical of the sun entering that constellation on the 21st. (See our engraving.)

The chronology of the month, replete with interesting records of past events, is subjoined.

1. Dr. Warren died, 1835.
2. Flaxman died, 1826.
3. Richelieu died, 1642.
4. Galvanism discovered, 1790—Mozart d. 1792.
5. Black died, 1799.
6. *Nicholas.*—General Monk born, 1608.
7. Dr. Aikin died, 1822.
8. Zimmerman born, 1728.
9. Scheele born, 1742.
10. Royal Academy of Arts instituted, 1768.
11. Grouse-shooting ends—Charles XII. killed, 1718.
12. Sir J. Brunel died, 1849.
13. *Lucy.*—Dr. S. Johnson died, 1784.
14. Washington died, 1799.
15. Brera born, 1772.
16. Leopold, King of Belgium, born, 1790.
17. Sir H. Davy born, 1778.
18. Rubens born, 1577.
19. Tycho Brahe born, 1588.
20. Gray born, 1716.
21. *St. Thomas.*—Shortest day.
22. Pott died, 1788.
23. Sir R. Arkwright born, 1732.
24. Christmas Eve.
25. Christmas Day.
26. *St. Stephens.*—Peyer born, 1653.
27. *St. John.*—Munro died, 1791.
28. *Innocents.*—Peter Bayle died, 1706.
29. John Wycliffe died, 1384.
30. R. Boyle died, 1691.
31. *St. Silvester.*—Boerhaave born, 1668.

The Red Letter Days of the month are as follow:—

6th.—"*St. Nicholas.*" He was Archbishop of Myra, in Greece, A.D. 302, and is regarded as the patron saint of children and mariners, and consequently churches built near to the sea are generally dedicated to this saint.

13*th*—"*St. Lucia*" was a young lady of Syracuse, who died in the year 304, and was remarkable for the devout and charitable life she led.

21*st*—"*St. Thomas*" is said to have travelled and promulgated Christianity among the Persians, Medes, Parthians, and Armenians, and that he met with his death by being stoned, and having darts thrown at him by the Brahmins, who were incensed at his preaching.

25*th.*—"*Christmas Day.*" This is kept as a solemn festival by our Church, and many curious customs prevail, which we have neither time nor space to describe, particularly as they are generally well known.

26*th.*—"*St. Stephen.*" This feast is held, according to Brady, "in consequence of St. Stephen having been the first who suffered for his steady adherence to the faith of Christ, so that his anniversary has been fixed immediately following the day held by the Church in commemoration of the Nativity of our Saviour."

27*th.*—"*St. John the Evangelist.*" This feast is observed in commemoration of this evangelist, because he drank poison without dying in consequence.

28—"*Childermas,*" or "*Holy Innocents' Day,*" is held in commemoration of the slaughter of the innocents by Herod, and is celebrated by the Church of Rome with masses. It is considered unlucky to begin any work upon this day.

31*st.*—"*St. Silvester*" was a pope, and is said to have been the author of several rites and ceremonies of the Romish Church, as unctions, palls, asylums, &c. He died in 334.

The old year, as it steals away, leads the mind to anticipate the gradual development of Nature. Cowper, in some beautiful lines, alludes to this:—

"These naked shoots,
Barren as lances, among which the wind
Makes wintry music, sighing as it goes,
Shall put their graceful foliage on again,
And more aspiring, and with ampler spread,
Shall boast new charms, and more than they have lost.
Then, each in its peculiar honours clad,
Shall publish even to the distant eye
Its family and tribe. Laburnum rich
In streaming gold; syringa iv'ry pure;
The scented and the scentless rose; this red
And of an humbler growth, the other tall,
And throwing up into the darkest gloom
Of neighbouring cypress or more sable yew,
Her silver globes, light as the foamy surf
That the wind severs from the broken wave.
Althea with the purple eye, the broom
Yellow and bright as bullion unalloyed,
Her blossoms, and luxuriant above all,
The jasmine, throwing wide her elegant sweets,
The deep dark green of whose unvarnished leaf
Makes more conspicuous and illumines more
The bright profusion of her scattered stars.
These have been, and these shall be in their day,
And all this uniform uncoloured scene
Shall be dismantled of its fleecy load,
And flush into variety again."

It is now that the departing year usually closes with raw and cold weather, to be succeeded, in general, with frost or snow, the severities of which are, in some measure, alleviated by the festive enjoyments of "merry old Christmas!"

LESSONS IN FRENCH.

PRONOUNS.

Of Demonstrative Pronouns.—Demonstrative pronouns are words the functions of which are not to name the object spoken of, or to specify it by its qualities, but to point it out among others of the same kind. In French they are divided into seven classes. 1st. Those which always precede a noun. 2nd. Those which always follow a noun. 3rd. Those which always precede a preposition, or a relative pronoun, and relate to definitive nouns. 4th. Those which, relating to nouns used definitely, are never followed by a noun, a preposition, or a relative pronoun, and signify, in English, *this ere one, that there one.* 5th. Those which relate to things or ideas before expressed in an indefinite manner. 6th. Those which are used with the verb *to be.* 7th. Those which, relating to some indefinite idea, precede a relative pronoun, and form with that relative pronoun a compound expression, expressed in English by *what,* or *which.*

Of Demonstrative Pronouns always placed before a Noun.—When the demonstrative pronouns *this, that, these,* and *those,* precede a noun, they are expressed in French in four different ways, according to the number and gender and the first letter of the noun following. *This* or *that, ce,* is used before a noun singular masculine, beginning with a consonant or *h* aspirated. *This* or *that, cet,* is used before a noun singular masculine, beginning with a vowel or an *h* mute; *This* or *that, cette,* is used before all feminine nouns in the singular; *These* or *those, ces,* is used before all plural nouns; as, This book, Ce livre. This hamlet, Ce *h*ameau. This work, Cet *o*uvrage. That man, Cet *h*omme. That woman, Cette femme. These men or women, Ces hommes et ces femmes. These pronouns relate equally to persons and things.

Whenever *this* and *that, these* and *those,* are used in English before a single noun, as these pronouns are, in such case, expressed by the same words in French, they should be rendered, in translating, by *such and such,* which will thus convey the meaning of the English; as, You seem to like to talk but to have an opportunity of mentioning this or that author. Vous semblez n'aimer à causer que pour avoir l'occasion de citer *tel ou tel auteur.* These pronouns may also be rendered in French by employing *ce, cet, cette,* or *ces,* before the noun, and placing the pronouns *ci* and *là* after it; as, Which do you prefer, this or that author? Le quel préférez-vous, *cet auteur-ci* ou *cet auteur-là?* or, *cet auteur-ci* ou *celui-là?* or, again, Le quel de ces auteurs préférez-vous, *celui-ci* ou *celui-là?*

Of Demonstrative Pronouns which always follow a Noun.—These pronouns are two in number, and have no other equivalent in English than the words *here* and *there,* placed after a noun by apposition, to point it out among others; they are expressed in French by *ci* for *here,* and *là* for *there;* in old times, they were used by themselves, and many examples may be found in our best writers; Madame de Sévigné made frequent use of them. She wrote, in a letter dated on the 16th of March, 1672, We shall see each other between this day and Easter,—Nous nous verrons entre *ci* et Pâques. But in our days this pronoun *ci* is only used after nouns of persons and things; *là* is sometimes employed alone, but it is only elliptically; as, I dislike this man, and that woman also, Je n'aime ni cet homme-ci, ni cette femme-là. He is there alone, Il est là seul. In the first example, *ci* refers to the nearest object, and *là* to the furthest. In the second, *là,* standing by itself, means, *in that place there, dans ce lieu là.*

Of Demonstrative Pronouns, which, relating to a Noun used in a definite sense, or preceded by the Adjective A, always precede a preposition, or a relative Pronoun.—We have already mentioned that class of pronouns, when speaking of personal nominative pronouns used in English before a relative pronoun; we will only state here that the demonstrative pronouns *this, that, these,* and *those,* are expressed by the same words as *he, she,* and *they,* in the same case; that is to say, *This* and *that,* by *celui,* relating to a noun singular masculine. *This* and *that,* by *celle,* a noun feminine. *Ceux,* a noun plural masculine. *Celles,* feminine. Thus, speaking of a book, which is masculine, we say, That of my brother. *Celui de* mon frère. Speaking of a cow, which is feminine, we say, That of my brother. *Celle de* mon frère. Speaking of books, we say, Those of my brother. *Ceux de* mon frère. Speaking of cows, we say, Those of my brother. *Celles de* mon frère. This pronoun is used in speaking of persons and things, and, as we see by the preceding examples, agrees in number and gender with the noun to which it relates; as in, He who does not know how to behave himself, can never command others. *Celui qui* ne sait pas se conduire, ne peut commander aux autres. I want a light; bring me that which is on the table. J'ai besoin d'une *lumière;* apportez-moi *celle qui* est sur la table.

The pronoun *celui* should not be separated by too many words from the noun to which it relates; thus the following sentence is incorrect: Courage, a quality peculiar to the French armies, always became fruitless, and often fatal, because prudence was not that of our councils. Le courage, cette *qualité* des armées Françaises, devenait toujours inutile et souvent fatal, parceque la prudence n'était pas *celle de* nos conseils.

This sentence is not incorrect because the pronoun *celle* could possibly relate to any other noun than *qualité,* but because the mind is not at once impressed with the relation existing between these two words; the latter part of this sentence should be altered in its construction, as follows: Parceque la prudence ne dirigeait pas nos conseils; or, parce que la prudence n'était pas la qualité de nos conseils (avoiding the use of the pronoun.)

The pronoun *celui,* when used as the antecedent of a relative pronoun, cannot be in French separated from that pronoun, as it is the case in English, unless it is by a noun or pronoun used with the preposition *of* as its object. Thus the following sentence, They are mistaken *who* think that happiness consists in riches, should be altered in its construction; as, They who think that happiness consists in riches, are mistaken; and expressed by, *Ceux qui* croient que le bonheur consiste dans les richesses, se trompent.

Whenever the demonstrative pronouns of this class are employed in a particular sense, at the beginning of a sentence, they always relate to a noun already expressed or understood, or mentioned afterwards, and may be used in either gender and number; as, She (of you ladies, understood) who will know her lesson well, shall be rewarded. *Celle qui* saura bien sa leçon, sera récompensée. But when these pronouns are used in a general sense, and are only intended to signify *the person*, or *the persons*, they cannot be used at all in French, their meaning being too vague and indefinite to be expressed by a pronoun of this class; the sentence should then be altered, and a noun used instead of the pronoun; as in, Those to whom I was speaking when you called me, are charming ladies. *Les personnes*, or *les dames*, à qui je parlais quand vous m'avez appelé, sont des femmes charmantes.

The pronouns which belong to this class can never be used in relation to a noun which is not preceded by the article *the*, or the adjective *a*; thus, the following sentence, That man is not wanting in courage, but that of his brother is far superior, cannot be translated literally, by, Cet homme ne manque pas de *courage*, mais *celui* de son frère est beaucoup plus remarquable, because *celui* refers to *courage*, which is neither preceded by *the* or *a*. It should be turned differently; as, for instance, by, Mais son frère est beaucoup plus brave, so as to avoid using the demonstrative pronoun at all.

The pronouns of this class can never be modified, either by an adjective, a past participle, or any expression of a similar nature; thus, in the following sentences, Among the letters we have just received, give me that which comes from England. Among these pens, give me that which is good to write with, the expressions *which comes*, and *which is good*, could not be replaced in French by the past participle *come*, and the adjective *good*, alone; and the following sentences, Parmi les lettres que nous avons reçues, donnez-moi *celle venue* d'Angleterre; and, Parmi ces plumes, donnez-moi *celle bonne* pour écrire, would be incorrect; they ought to be constructed in French as they are in English; as, Parmi les lettres que nous avons reçues, donnez-moi *celle qui vient* d'Angleterre. Parmi ces plumes, donnez-moi *celle qui est* bonne pour écrire.

The pronouns of this class may sometimes be elegantly suppressed in sentences like the following: He who wishes to be feared, is seldom loved. Qui veut se faire craindre, est rarement aimé. If the death of Socrates was that of a wise man, that of Christ was that of a God. Si la fin de Socrate *est d'un sage*, la mort de Jésus-Christ *est d'un Dieu.*

Whenever, at the beginning of a sentence, *such* is used for *he, she, they, those*, &c., it is rendered in French as these last pronouns would be; as in, Such as seem to be happy, are not always so. *Ceux qui* semblent heureux, ne le sont pas toujours.

Of Demonstrative Pronouns, which, relating to Nouns used Definitely, are never followed either by a Noun, a Preposition, or a Relative Pronoun, and signify in English, this ere one, that there one.—The demonstrative pronouns of this class are composed of those of the two last; that is to say, of the word *celui*, followed by *ci* or *là*. They point out a person or thing, and have the meaning, *celui-ci* of *this ere one*, *celui-là* of *that there one*. They agree in number and gender with the noun to which they relate. Thus, speaking of two men, we say, This is a good one, but that one is wicked, *Celui-ci* est bon, mais *celui-là* est méchant. Speaking of two ladies, This one is handsome, but that one is ugly, *Celle-ci* est belle, mais *celle-là* est laide. Speaking of horses, These are gentle, but those are restive, *Ceux-ci* sont doux, mais *ceux-là* sont rétifs. Speaking of peaches, These are ripe, but those are green, *Celles-ci* sont mûres, mais *celles-là* sont vertes. In sentences similar to these, the pronoun *celui-ci* designates the nearest objects, and *celui-là*, the most distant.

Of the Pronouns Celui-ci *and* Celui-là, *used in relation to one Noun only.*—Whenever the demonstrative pronouns of this class are preceded by one noun only, *celui-ci* and *celui-là* are indifferently used in reference to that noun; as in, Lovely spring succeeds gloomy winter; after fair weather comes rain; fine weather succeeds to this again, Après sombre hiver gai printems; après joli tems triste *pluie*; après *cellui-ci* le beau temps. Had I written this book in a dogmatic style, learned people only would have read it, and these had no need of it, Si j'avais écrit cet ouvrage d'un style dogmatique, les *savants* seuls l'auraient lu, et *ceux-là* n'en avaient pas besoin.

Of the Demonstrative Pronouns Celui-ci *and* Celui-là, *relating to no Noun already expressed.*—When a sentence is intended to express the enumeration of several persons or things, the pronouns *celui-ci* and *celui-là* may be used, without relating to any noun already expressed; as in, Applauded by all, but also polite and affable to all, she anticipated the wishes of some, and replied politely to others, Applaudie de tous, mais à son tour affable et civile à tous, elle prévenait *ceux-ci*, et répondait honnêtement à *ceux-là*. In cases similar to these, *celui-ci* relates to what comes first to our mind, and *celui-là* to what comes next.

Of the Demonstrative Pronouns Celui-ci *and* Celui-là, *followed by a Relative Pronoun.*—*Celui-ci* and *celui-là* are not generally followed by a relative pronoun when used as nominatives; the pronoun *celui*, and the incidental sentence of which the relative pronoun is the nominative, being sufficient to point out the person or thing spoken of; but some of our good writers have made use of them in such cases; as in, He who lives unknown by the world, lives happy, *Celui-là qui* vit ignoré, vit heureux; or, *Celui-là* vit heureux, qui vit ignoré. But when the pronouns *celui-ci* and *celui-là* are employed as the object of a verb, they may very properly be followed by a relative pronoun, provided this pronoun does not form, with the following verb, an incidental proposition, used in apposition to the demonstrative pronoun; as in, I brought you a book, but your mother told me this was not the one you wanted, Je vous ai apporté un livre, mais votre mère m'a dit que ce n'est pas *celui-là dont* vous avez besoin. Speaking of a lady, Is this the one you wish to marry? Est-ce *celle-ci que* vous voulez épouser? Speaking of two men, Is this the one who has insulted my sister? Est-ce *ceuil-ci qui* a insulté ma sœur?

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EDUCATIONAL AND SCHOLASTIC MATTERS.

THE PHILOLOGICAL SOCIETY.

This Society, which was originally established for the cultivation of Philological Science, and the general investigation of language, appears to be proceeding in a prosperous career; and many papers of an extremely interesting character have been lately read and discussed. On the 11th inst. a paper was read by Professor Key "on some alleged distinctions in languages, believed to be without foundation." After noting the systems of Schlegel and Bopp, and the fallacies they advanced, he observed that the language of the Chinese had a peculiar monosyllabic character, and no grammatical formations. Chinese, though rich in monosyllabic words, has plenty of dissyllables, trisyllables, and polysyllables. Take a short example :—

Yih-ko-jin heo kwán-hwa tai, tso shim-mo-ti ne?
Now a man in learning the Mandarin language, what is his object?

As to grammatical formations, a certain syllable affixed to a substantive expresses the relation which Europeans denote by the term genitive case, another syllable may express the plural, and so on. And if it be true that these affixes have an original meaning of their own, so, we know, had the *m*, *s*, *t*, of *regam*, *regas*, *regat*, and the affixes of many other words, and so had every affix. They have also a parallel to our formation —"moonlight" for "moon's light." As to the alleged distinction between word-building by addition of affixes, and word-building by what some call inflexion, the two results are the effect of the same process. *Dominus* contains the two significant words *domino*, meaning "master," and *s* (originally some fuller form), the source of action; while *dominum* in the final *m* contains the spectre of some once-existing word denoting an object. Such plurals as *men*, from *man*, are formed by the singulars having once had a suffix *es*, or *er* or *en*, and their strong vowels having been affected by the weak vowel of the suffix, and the suffix being then dropped; so that *manner*, *männer*, *mönne*, *men*, would represent the change of our example. The long *e* of the Latin perfect vēnit as compared with the short *e* of the present vĕnit arises from vēnit being a contraction of a reduplicated velvĕnit, as vellit of vevĕlit, vertit of vevertit and visit of vevisit. The term polysynthetic or polysyllabic is applied to the American languages and the Basque. People who were brought into contact with the Red Indian had no resource but to take down, as they best could, what they heard from his mouth, and as a natural consequence, a whole clause spoken with unbroken utterance was honestly transferred to paper as a single word, and then by simple-minded Europeans, accepted as something most strange. "The Aztec language is very regular in its construction and abounds in words suited to compliment. The word *notlazomahuizteopixcatàtzin*, that is, 'my esteemed lord and reverend priest and father,' is the word commonly used by a Mexican in addressing a priest." The ordinary view that every root in the Semitic tongues contains three consonants has been doubted by many scholars. Though the native teachers of Hindústani trea the roots of that language as dissyllabic, all the ablest Sanscrit scholars are agreed that the roots are monosyllabic, and that Hindústani is but a child of Sanscrit. The learned lecturer concluded by expressing his belief that all languages were formed from monosyllabic roots; that the formation of all languages was by the agglutination of syllables, each of which was a self-significant word, although, in the agglutinated form, one took precedence of the other in importance, and consequently in accent.

SCHOOLMASTERS' ASSOCIATIONS.

We are happy to observe that these associations, so admirably calculated to unite the scholastic profession in the bonds of friendly communion, are every day increasing in number and importance. The "Brighton and Sussex Church Schoolmasters' Association," of which the Bishop of the diocese is the patron, have lately published their rules and resolutions, which state that the Society is established for "the mutual improvement of its members, especially in all those subjects practically connected with the duties and position of the educator. Its objects are to be carried out by means of lectures, essays, discussions, classes, the circulation of periodicals, and the formation of a library of standard educational works. A "Yarmouth District Association" has also been formed, professing similar objects; and its rules have been published. A prospectus has likewise been issued for the establishment of a "Bath District Association;" and a meeting of teachers of Church Schools was lately held in the Trinity Church School, Nottingham, for the purpose of forming a Schoolmasters' Association.

A PICTURE FROM THE HINDOO COLLEGE AT CALCUTTA.

Mr. Capper, in his "Three Presidencies of India," gives the following picture, drawn from the life:—"On any ordinary day the visitor will see, on a table in the midst of a small room, one of the 'professors' sitting in Oriental fashion, after the manner of tailors: his head is bare, his shoulders are bare; the day is hot, and the roll of muslin which envelopes his body out of doors has been removed; the ample rotundity of the stomach heaves regularly above the muslin folds which encircle the loins and thighs. The shaven crown of the worthy 'professor,' and his broad quivering back, glow with the heat; whilst a disciple, standing behind him, plies the fan vigorously to and fro, and produces a current of wind that keeps the huge mass partially cool. Around the table are squatted numbers of dirty-looking youths, carefully enveloped in their muslin dresses, as prescribed by the rules, and droning, one by one, over a manuscript page, which is handed from one to another in succession. The majority are dozing; and well they may, for it is sleepy work—the same verses nasally intoned by one after another with unvarying monotony, and doubtless with similar errors. The 'professor' seldom speaks, for he too is dozing heavily on the table, anxiously awaiting the bell that is to release him to liberty and dinner. The same scene is being repeated in other similar rooms, where other 'professors' are similarly dozing and teaching, and other youths similarly shut up from the light of God's sun, which shines without, and of his soul, which should shine within them.

DEAL PAROCHIAL SCHOOLS.

These schools, the foundation stone of which were laid in September, 1852, have been lately opened, and are now in full operation, under the superintendence of a master, mistress, and infant-mistress. There are two residences for the teachers, and each schoolroom has a play-ground attached. The building presents a handsome appearance in the approach from Sandwich to Deal. It was designed by Mr. Paynter, of Westminster; and its cost (including the site, which amounted to £2,300) has been defrayed by grants from the Committee of Council, the National Society, and the Diocesan Board, besides large contributions from private individuals. The schools will accommodate about 300 children.

WORKHOUSE SCHOOLS.

The Poor-law Board have organized a supply of books to workhouse schools at an average reduction of 45 per cent. on the public prices of the volumes. The books include the ordinary course of instruction—those on "vocal music," "political economy," "astronomy," and "mental philosophy," remind us how ambitiously we now profess to teach even the paupers we support.

EFFECTS OF EDUCATION ON CRIME.

In the years 1840 and 1841, in twenty counties of England and Wales, with a population of 8,724,338, there were convicted only 59 instructed persons, or one in every 147,870 inhabitants; while the remaining thirty-two counties, with a population of 7,182,491, did not furnish one convict who had received more than the rudest elements of instruction. Among the 59 just mentioned, 14 were political offenders,

SCHOOL OF DESIGN.

At Newcastle-under-Lyne a branch School of Design was lately opened, when its objects were fully explained by the chairman of the meeting. The Board of Trade has appointed Mr. Williamson as the master of the elementary drawing school.

SWANSEA GRAMMAR SCHOOL.

A new Grammar School has been lately erected at Swansea. It is of the Tudor-Gothic style, with high pitched roofs and gables, and broad mullioned windows with stained glass. At the eastern portion of the building there is a bell-tower and clock, which impart an interesting appearance to the whole. The entire structure is 200 feet in length.

THE EDITOR AND HIS CORRESPONDENTS.

With the present number of the Tutor we have issued another portion of the work on "British Plants and Structural Botany;" and our correspondent, "A Zealous Botanist," may rest assured, that every care will be taken to render the publication worthy of the scientific spirit of the age.

A Pupil expresses doubts as to the ancients possessing any intimate knowledge of Short Hand, as practised at the present day. The classical ancients were certainly not unacquainted with the principles and practice of this useful science; although we are not informed of the peculiar systems which they carried into operation. Diogenes Laertius mentions two modes of short-hand writing in use among the Greeks—one by contraction of words and the other by arbitrary marks. The art was practised among the Romans at an early period. Ennius is said to have invented, and Tyro, Cicero's freedman, to have improved, a system of short-hand, by which the writer was enabled to follow the most rapid speaker. Plutarch, in his life of Cato, informs us that the celebrated speech of that patriot against the accomplices of Catiline, was taken and preserved in short-hand. Suetonius mentions it as something remarkable, that Caligula, who was so expert in other matters, and wanted not capacity and parts, was totally ignorant of this mode of writing. He also mentions with great praise the expertness which Titus acquired in it.

W. S.—Algebra is generally admitted to be an Arabic invention, and brought first into Europe by the Moors, who settled in Spain. From thence it passed into Britain. A system of Algebra was written by Diophantus in Greek, about the year 800 of the Christian era; but not published till the year 1575. Yet this art is supposed to have been in use among the Arabs much earlier than among the Greeks; and it has been contended that the Arabs borrowed it from the Persians, and the Persians from the Indians. The first who wrote on the subject, in modern times, was Lucas Paccioius, or Lucas de Burgos, a cordelier; whose book, in Italian, was printed at Venice, in 1494.

Agapæ—J. C. S.—Among the primitive Christians, these Agapæ were a kind of love-feasts, at which a liberal contribution was made by the rich to feed the poor. These love-feasts were celebrated in memory of the last supper, and were kept in the church, towards the evening, after the common prayers were over. The ceremony usually concluded with the kiss of charity between the different sexes. St. Chrysostom thus notices them:—"The first Christians had all things in common, as we read in the Acts of the Apostles; but when that equality of possession ceased, as it did even in the Apostle's time, the agapæ, or love-feast, was substituted in the room of it. On certain days, after partaking of the Lord's Supper, they met at a common feast; the rich bringing provisions, and the poor who had nothing being invited." After the three first centuries these love-feasts degenerated into licentiousness, and the abuses committed in them became so notorious, that the holding of them (at least in churches) was solemnly forbidden at the Council of Carthage, in 397.

Historical Inquirer.—The "Social War," as it was anciently called, is familiar to the readers of Roman history. It was applied to a celebrated contest between the Socii of Italy and the city of Rome, which lasted from 91 B.C. till 89, and was the most formidable war ever carried on in Italy during the dominion of the Romans. It arose from the desire of the Italians to be placed on a footing of equality with the Romans. Nearly 300,000 lives were sacrificed in the contest, and numerous towns destroyed. The Senate of Rome were at length compelled to grant the franchise and all other privileges, which they had at first absolutely refused to the Italians.

Quærens.—The river God, as it is termed, which is situated in the quadrangle of Somerset House, is the representation of Father Thames, and was executed by John Bacon, R.A., at a cost (including the bronze statue of George III.) of £2,000. It is admitted to be one of the best executed public monuments in London.

Parker's Cement—Artifex.—This cement, so valuable in the arts as a concrete, is made of the nodules of indurated and slightly ferruginous marl, called by mineralogists *Septaria*, and also of some other species of argillaceous limestone. These are burnt in conical kilns, with pit coal, in a similar way to other limestone; but care must be taken to avoid the use of too much heat; for if the pieces undergo the slightest degree of fusion, even on the surface, they will be unfit to form the cement. After being properly baked, the calx is reduced to a very fine powder by grinding, and immediately packed in barrels, to keep it from the air and moisture. When applied to use, the powder is tempered with water to a proper consistence, and applied at once, as it soon hardens, and will not bear being again softened down with water.

G. E. Burdlots.—The wires of a galvanic battery are copper.

C. S. D.—Your questions are purely geometrical, which could not be elucidated without correct diagrams, and a mathematical process of working.

NATURAL PHILOSOPHY.

Second Division.

THE PROPERTIES OF HEAT—THERMOTICS.

CHAPTER LIII.

THE STEAM-ENGINE.

Elementary Steam Engine—Forms of this Machine—Description of the High-Pressure Engine—Principle of the Low-Pressure Engine—Description of the Double-Acting Engine—Estimate of Performance.

On the elastic force of steam, and on the rapidity with which it is condensed, by application of cold, the construction of the different forms of steam-engine depends.

The instrument represented in Fig. 311, gives a clear idea of the elementary parts of a steam-engine. It consists of a cylindrical glass tube, B, terminating in a bulb, A. In the tube a piston moves up and down, air-tight, and a little water having been placed in the bulb, it is brought to the boiling point by the application of a lamp. As the steam forms, it presses the piston upward by reason of its elastic force, and, on dipping the bulb into cold water, the steam condenses and produces a partial vacuum, the piston being driven downward by the pressure of the air.

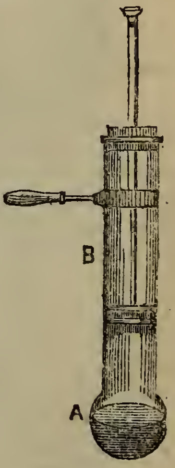

Fig. 311.

There are a great many modifications of the steam-engine. They may, however, for the most part, be reduced to two kinds: 1st, high-pressure engines; 2nd, low-pressure engines.

The high-pressure engine, which is the simplest of the two forms, consists essentially of a very strong iron vessel or boiler, in which the steam is generated, a cylinder in which a steam-tight piston moves backward and forward, an arrangement of valves or cocks, so adjusted as alternately to admit the steam above and below the piston, and also alternately to let it escape into the air, and lastly a suitable contrivance by which the oscillations of the piston may be converted into other kinds of motion, suited to the work which the engine has to perform.

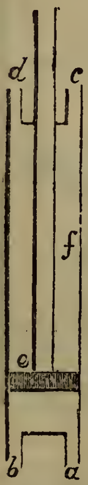

Fig. 312.

The action of the steam in one of these machines may be understood from the annexed diagram, Fig. 312. Let *f* be the cylinder, in which a solid piston, *e*, moves, steam-tight, and let us suppose the piston near to the bottom of the cylinder. The steam is now admitted through an aperture, *a*, and by its elastic force pushes the piston to the top of the cylinder. The movement of the piston-rod rearranges the openings into the cylinder, closing at a particular moment *a*, through which the steam has already come, and opening *b*; simultaneously, also, it opens *c* and closes *d*. Through *c*, from the boiler, a fresh supply of steam arrives, while it is shut off from *a*. This steam cannot escape through *d*, because that is closed—it therefore takes effect upon the piston and pushes it downward, all the vapour beneath escaping out into the air through *b*, which has been opened. This downward movement of the piston-rod rearranges all the valves, reversing the positions they have just had. It therefore opens *a*, shuts *b*, opens *d*, and shuts *c*. Steam now comes in from the boiler, through *a*, but cannot escape through *b*; it therefore pushes up the piston, driving out the steam, which is on its opposite side, through *d*, and in this way a reciprocating motion is produced.

The means of opening and shutting the apertures leading into the cylinder at the proper moment differ in different engines—sometimes cocks are used, and sometimes sliding valves.

In this engine, therefore, the piston moves in both ways against the pressure of the air. The steam must be necessarily raised from water at a high boiling point, and hence these machines are much more liable to accident than the low-pressure engine, now to be described.

The rapid condensibility of steam—a principle intimately concerned in the action of the low-pressure engine—may be illustrated in the following manner: Take a glass flask, *a*, Fig. 313, and adjust to its mouth a wide bent tube, *b*, both ends of which are open, having previously placed a quantity of water in the flask. Apply the flame of a spirit-lamp, and bring the water to the boiling point, continuing the ebullition until all the air is driven out of the flask, and nothing but steam remains. Then dip the open end of the tube into the jar, *c*, containing some cold water, and remove the lamp; the steam in the tube will at once begin to condense, through the influence of the cold water, which soon rises over the bent portion, and precipitates itself into the flask, often with so much violence as to break it to pieces.

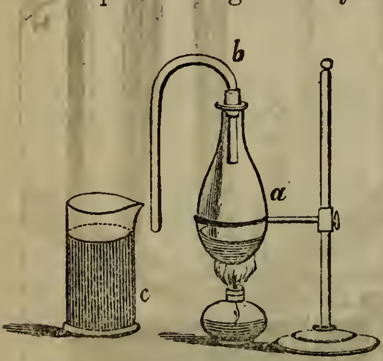

Fig. 313.

Of the low-pressure engine we have varieties—such as the single-acting and the double-acting engine. In the former, the piston is driven one way by means of steam acting against a vacuum, returning the other way by the counterpoising weight of the machinery. The machine, therefore, in reality, is only in action during half its motion.

The double-acting engine has the steam employed to produce both the ascent and descent of the piston into a vacuum on the opposite side. It therefore works continuously.

In expansive engines the supply of steam, instead of being continued during the entire ascent or descent of the piston, is cut off when the movement is one half or one third accomplished; the expansion of that steam driving the piston through the rest of the cylinder.

The following is a description of the double-acting engine. Fig 314 represents the boiler and its appurtenances; Fig. 315 the engine.

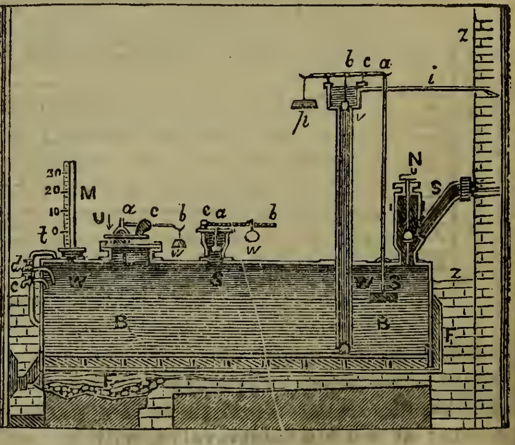

Fig. 314.

B B, Fig. 314, is the boiler, of a cylindrical shape, the fire, F F, is applied beneath; W W is the water-level, and S is occupied by steam. At *t t* there is a bent glass tube, open at both extremities, and so arranged that one end is in the steam space, and the other in the water; it serves to show the level of the water in the boiler. In some cases, two cocks, *c* and *d*, are inserted in the boiler, one entering into the steam part and one beneath the water. On opening them, if the water is at its proper level, steam will escape from the upper, and

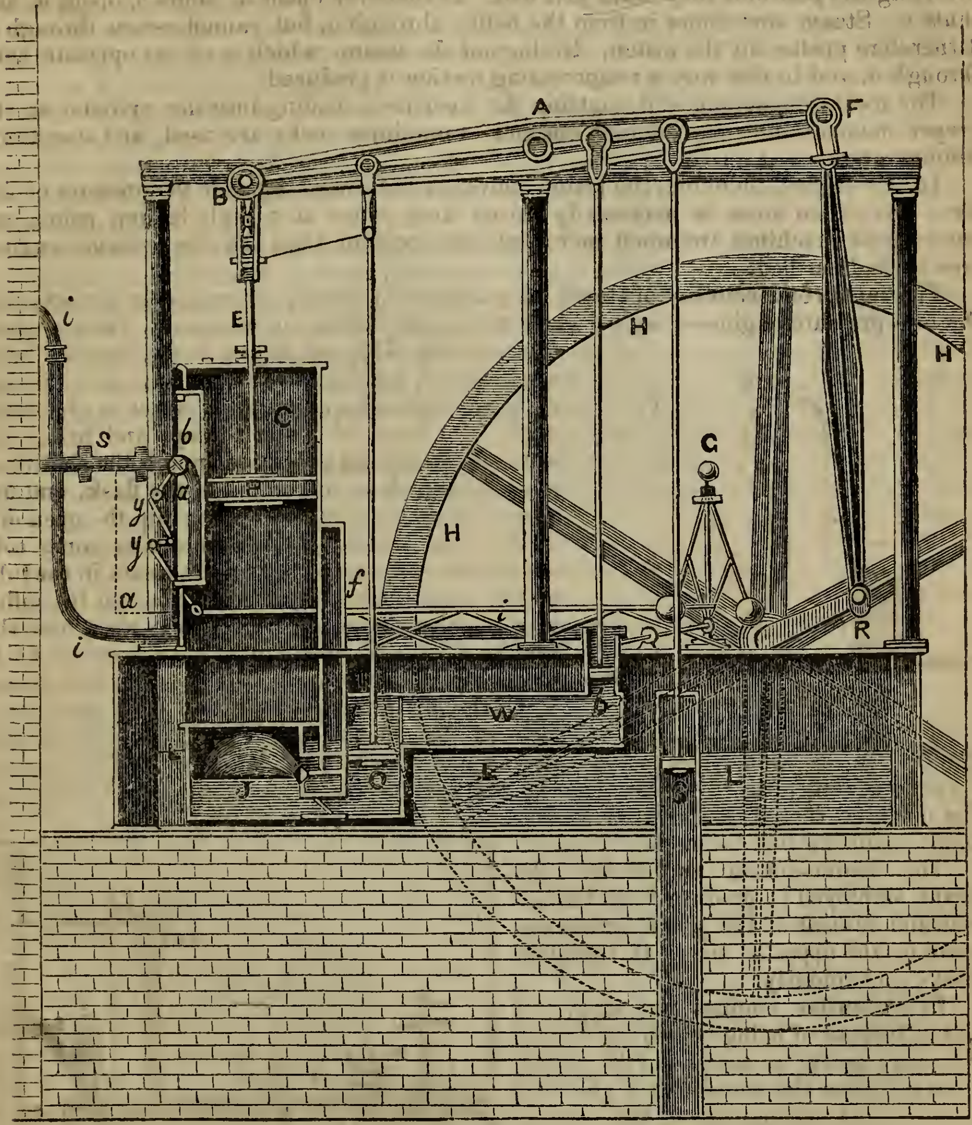

Fig. 315.

water from the under one. If there is too much water, it escapes from both. The boiler is continually replenished by the *feed-pipe,* the nature of which has been explained in Chapter XIV. At M there is a barometer-gauge, to show the elastic force of the steam; at *e a b* a safety-valve, with its weight, *w*; this opens upward, so that, should the elastic force in the interior of the boiler become too great, the valve opens, and the steam escapes. On the contrary, to prevent the boiler being crushed in by the atmospheric pressure, when the expansive force of the steam happens to decline, there is a second valve at U, with its lever, *a c b*, and weight, *w*, which opens inward, that, when the external pressure exceeds the weight, the air may find access to the inside of the boiler. And, as it is necessary from time to time to clear the boiler from the incrustations or deposits of salt and other impurities, there is an opening, as at L, through which access can be had. This, of course, is, at other times, securely closed. Lastly, from the boiler there passes the steam-pipe, *s*, which is opened by the valve at N.

Fig. 315 represents the engine, properly speaking. At *z z* it should be imagined as being continuous with *z z* of Fig. 314; so that in both figures the tubes *i i* and *s s* are continuous. In both *s* is the tube along which the steam from the boiler is delivered to the cylinder. Passing through the *four-way* cock, *a*, either down through *a* or up through *b*, into the cylinder C, in which the piston, P, moves. Admission for the steam, above or below the piston, is regulated by a system of levers, *y y*, the necessary motion being communicated by the machine itself. The piston-rod, E, is connected with the beam, B F, working on the fulcrum, A. The connecting-rod is F R. At R it is attached to the crank by a pivot, H H H, being the fly-wheel, the revolution of which gives uniformity to the motion. The steam, after elevating or depressing the piston, passes through the eduction-pipe, *f f*, into the condenser, J, which is immersed in a cistern, L, of cold water. In this it is condensed into water by a jet which passes through the injection-cock. The resulting warm water is pumped out by the air-pump, O, into the hot well, W; thence it is carried, by the hot-water pump, *b*, along the feed-pipe, *i i*, into the boiler. The cold-water pump, S, supplies the reservoir with cold water. All the pumps are worked by the beam of the engine. The supply of steam is regulated by the governor, G, so as to be kept constant.

The performance of steam engines is commonly estimated by horse-power. The value of the power of one horse is a force sufficient to raise 33,000 pounds one foot high in one minute.

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OUR NATIVE LANGUAGE AND AUTHORS.—No. III.

GOWER—BARBOUR—WYNTOUN.

The names of Chaucer's contemporary writer, John Gower, and of those who immediately followed, Barbour and Wyntoun, are but little known to the general reader. Their genius will not bear a comparison with that of our father poet; yet a few recollections of them and of their works will not be without interest.

It is pleasant to think of a poet, secure from the poverty so proverbially the poet's fate, and devoting his wealth to good and noble purposes;—thus can we recall visions of Gower. He was of gentle if not of noble birth; he was, like Chaucer, brought up to the law. We hear of his munificent contributions towards the building of the Church of St. Mary Overy, in Southwark. An anecdote remains of his taking the air in his barge, on the Thames, when he was met by King Richard the Second, and invited into the royal barge,—of his having much conversation with the monarch, and being desired by him to "book some new thing," or to write another work, Gower obeyed, and produced his "Confessio Amantis."

Gower's earliest poetic efforts were probably in French; and some very pretty sonnets, in that language, remain of his composition. His great works are, the "Speculum Meditantis," which has never been printed,—a sort of moral essay, in verse, illustrating, by examples from various authors, the happiness of conjugal fidelity; this, being in French, does not assist the progress of our native language. Neither does his poem, the "Vox Clamantis," which is in Latin. It is a sort of metrical chronicle of the insurrection of the Commons in Richard the Second's reign. His "Confessio Amantis" is in English, and is a long dialogue between a lover and his *confessor*, who is a *priest of Venus*, and is called Genius.

As every vice is in its nature unamiable, it ought to follow that immorality is unavoidably punished by the indignation of the fair sex; and every fortunate lover should be, of necessity, a good Christian. On this presumption, the confessor passes in review all the defects of the human character, and carefully scrutinises the heart of the penitent with respect to each, before he will give him absolution.

It may well be imagined, that some curious matter would be interwoven in a poem, such as we have described; indeed the very plan of it, founded on confession and absolution (which, in Gower's day, were in such universal practice, as to make them a not unnatural vehicle for a tale) appears to us a most droll device. Almost all the learning of the age is introduced into this elaborate work; and it concludes in a way that may startle the lovers of modern novels and tales.

After listening to the instructions of his confessor, in chemistry and Aristotelian philosophy,—after trying to excite compassion by the details of his sufferings, and patient courtship,—he informs us that he is arrived at such a good old age, that the conquest of his inflexible lady fair would be no triumph!

Chaucer, who knew and loved this poet, speaks the character of his works most justly in the epithet, the "Moral Gower," —no slight praise, especially in those days.

Several tales are mingled with the more abstruse parts of his poem, one of which—the "Legend of Florent"—was also related by one of Chaucers's Canterbury pilgrims. It is of a young knight, who, having slain his enemy's son in battle, being afterwards taken prisoner, is made the subject of discussion after the combat; his captors thinking it contrary to the good feelings of chivalry to put a man to death for doing his duty in fight, and yet the loss of the commander's son is too great, and the father's sorrow is too acute, to allow it to pass unrevenged.

> "Fain they would do vengeance
> Upon Florent, but remembrance
> That they took of his worthiness,
> Of knighthood and of gentleness,
> And how he stood of cousinage
> To th' Emperor, made them assuage,
> And durst not slayen him for fear.
> In great disputes on that they were,
> Amongst themselves, what was best.
> There was a lady, the slyest
> Of all that men knew then;
> And she said she should bring him in,
> That she should him to death win,
> All only of his own grant,
> Through strength of very covenant.
> Without blame of any wight,
> Anon she sent for the knight;"

And told him he might be saved from death, if he would tell what it was that all women most desired, so that none could contradict. He should be allowed time and freedom, if he would promise to return at the stated period, and tell his "*avise.*"

Of Gower, we shall say no more than that he was buried in the Church of St. Mary Overy, and his tomb still remains.

Barbour and Wyntoun were both Scotchmen, and both ecclesiastics. The first, Archdeacon of Aberdeen; the last, a Canon regular of the Priory of St. Andrews, and, afterwards, Prior of St. Leof's Island, in Lochleven.

The materials for the lives of Barbour and Wyntoun are scanty. Barbour was born in 1326; and, at the age of 31, was Archdeacon of Aberbeen. In that year he went to Oxford, in order to place three students there. In the same year he was appointed, by the Bishop of Aberdeen, one of his Commissioners to treat of the ransom of David, King of Scotland, who was, at that time, a captive in England. He was in England in 1365, and passed through the country in company with six knights, on their way to St. Denis, in France.

Barbour does not mention Chaucer in any of his works; therefore it is probable he did not remain long in England, or he would have become acquainted with him. His great poem is, "The Bruce," a biographical and historical work of about 14,000 verses, which is believed to give an authentic account of the adventures of Bobert Bruce. The language is remarkably good for his time. The characteristics of the poem are spirit and plain sense. It contains many interesting pictures of the manners of the time. These few lines, on Freedom, are the only specimen for which we have space:—

> "Ah! freedom is a noble thing;
> Freedom makes man to have liking.
> Freedom all solace to man gives;
> He lives at ease, that freely lives!
> A noble heart may have none ease,
> Nor ele's, nought that may him please,
> If freedom fail; for free liking
> Is yearned above all other thing."

Thus the reader may observe the language of Scottish writers was, at this early period, English, of as good and modern a kind as that of our own best author. Barbour died in 1396.

Andrew Wyntoun wrote the "Orygynale Cronykil" of Scotland; or, the history of that country, from the creation of the world to the year 1408. It may be well imagined that it contains many strange traditions and tales. It would be very difficult for the annalist of such a lengthened period to do more than relate his events in the plainest manner; but Wyntoun has varied his rhymes with great ingenuity, and there are sometimes touches of true poetic description. His legend of Macbeth is interesting. The poet delights in descriptions of tournaments and deeds of chivalry; and enters into all the detail of ceremony, and of the splendour of the knightly equipment.

LYDGATE.

Of the immediate successors of Chaucer, "Dan. John Lydgate" was one of the most popular and remarkable. Had he written a chronicle of his own days, it would not have failed to be a work of high interest; for he lived in a most eventful period of English history. He was born in 1375, two years before the death of Edward the Third; and he survived till 1461, when Edward the Fourth established himself as King. The instability of human greatness might have been a fertile theme to him who witnessed the fall of two Princes (Richard the Second and Henry the Sixth), and who lived through the rise, the glory, and the overthrow of the House of Lancaster; but his most important work, which was undertaken at the command of Henry the Fifth, is a metrical history of the siege of Troy.

Of the private life of this author little is known. He was a Monk of the Benedictine Abbey of Bury, in Suffolk. He received his education at Oxford; and afterwards travelled in France and Italy, where he studied the works of the best authors, and made himself master of the literature and language of both countries. On his return to England he opened a school in the monastery, where he instructed the sons of the nobility in polite learning, and the art of versification. His industry must have been great. His own compositions are very numerous; to name them all "would be to write the catalogue of a little library." No poet seems to have possessed greater versatility. Whether his subject be the life of a hermit or a hero—of St. Austin or Guy Earl of Warwick—ludicrous or legendary—sacred or profane—a history or an allegory—he writes with facility. If a disguising was intended by one of the city companies—a masque to be performed before the King at Eltham—a May-game or mumming—a pageant or procession—so well was Lydgate's readiness known, that he was almost invariably applied to for the poetry.

His three works are, "The Fall of Thebes," intended as a continuation of Chaucer's "Canterbury Tales;" but it will not bear a comparison with the elder poet's work. "The Falls of Princes," of which Lydgate had such eminent instances, is, unfortunately, a translation from the French, and does not refer to events of his own time. "The Siege of Troy" is also a translation from a prose-history by Colonna, and professes to be "the only true and sincere history of the wars between the Grecians and the Trojans."

The author begins with the expedition of the Argonauts in search of the Golden Fleece. In the course of it he mentions the "*uncourtesy*" offered by Laomedon, King of Troy, to Hercules and Jason, which is said to have caused the destruction of the city. It was rebuilt by Priam, in whose time occurred the famous ten years siege. The details of the voyage of the Argonauts are given by Lydgate with as much precision as if he had been one of the company; and they are curiously interwoven with descriptions of rites appropriate only in his own time. For instance, King Aetis is said to go to dinner with his "lordes all, and with his *knights* about him every one;" and he tells that Troy, which he makes to have been built with grey marble and "alabaster white," had—

"Through the wall their foemen for to let,
At every tower *great guns* y set."

There were, besides, portcullises, locks, chains, and all the defences of the middle ages. For convenience and amusement, "*decambulatories*," or covered ways, were provided "for men to walk together, twain and twain;" and for ornament, the streets were paved with stones in chequer-wise, white and red.

In a poem, called "London Lickpenny," are some amusing particulars respecting the metropolis. In a very different style from "Bleak House," he exposes some of the abuses of the courts of law. The poet is supposed to come to London in search of legal redress, on some occasion; and to visit successively the King's Bench, the Court of Common Pleas, the Court of Chancery, and Westminster Hall, where, for want of money,—

> " Within the hall, neither rich nor yet poor
> Would do for me aught, although I should die;
> Which seeing, I gat me out at the door."

Lydgate had no sooner left Westminster Hall, than—

> " Flemings began on me to cry,—
> 'Master, what will you copen,[*] or buy?
> Fine felt hats ? or spectacles to read ?
> Lay down your silver, and here you may speed.'
> Then to Westminster Gate I presently went,
> When the sun it was at high prime,
> And cooks to me they took good intent,
> And proffered me bread with ale and wine,
> Ribs of beef, both fat and full fine,
> A fair cloth they began for to spread;
> But, wanting money, I might not speed."

From this we find that "necessary evil," money, was as requisite in the more simple days of our forefathers as in our luxurious ones; and that, though rushes strewed their floors, these natural carpets had to be bought, as much as if they had been velvet pile imitations of the same plant.

H. M.

◆

THE ENGLISH OF OUR EARLY ANCESTORS.

After more than a century from the Conquest, the national distinctions began to decline, and both the Norman and English languages were heard in the houses of the great. A remarkable proof of this is, that the most diligent inquirers after ancient rhymes find the earliest they can discover in the mouths of the Norman nobles. Such as that of Robert Earl of Leicester and his Flemings, in 1173, in the reign of Henry II., recorded by Lambarde in his his Dictionary of England :—

> " Hoppe Wyliken, hoppe Wyliken,
> Ingland is thine and myne," &c.

And that noted boast of Hugh Bigot, Earl of Norfolk, in the same reign of Henry II. :—[†]

> " Were I in my Castle of Bungey
> Vpon the river of Waueney,
> I would ne care for the King of Cockeney."

Indeed many of our old metrical romances, whether originally English, or banished from the French to be sung to an English audience, are addressed to persons of high rank, as appears from the beginning thus :—

> " Listen, lordlings," &c.

These were prior to the time of Chaucer. Richard I. is not known ever to have uttered a single English word, unless we may rely on the evidence of Robert Maunyng for the express words, when of Isaac King of Cyprus,—" O dele," said the king, "this is a foul Breton." The latter expression seems proverbial, whether it alludes to the Welsh or to the Armoricans, because Isaac was neither by birth, though he might be both by folly.

" Many great nobles of England, in this century," says Ritson, "were utterly ignorant of the English language." As an instance, he mentions the case of William Longchamp, Bishop of Ely, Chancellor and Prime Minister of Richard I., who, according to a remarkable account in a letter of his contemporary, Hugh Bishop of Coventry, did not know a word of English.

The only fact relating to this subject, in connection with John or his reign, that Ritson brings forward, is the speech which that king's ambassadors made to the King of Morocco :[†]—" Our nation is learned in three idioms, that is to say, Latin, French, and English."

Robert of Gloucester, in his *Chronicle*, provides us with a specimen of our language at the commencement of the reign of Edward I., and at the same time mentions the fact of the prevalence of the French tongue in England, down even to this date, more than two centuries after the Conquest :—

> " Thus come lo! Engelonde into Normannes honde,
> And the Normans ne couthe speke tho bote her own speche,
> And speke French as dude atom, and here chyldren dude al so teche,
> So that hey men of thys lond, that of her blod come,
> Holdeth alle thulke speche that hii of hem nome."

That is, literally:—" Thus, lo! England came into the hand of the Normans; and the Normans could not speak then but their own speech, and spoke French, as they did at home, and their children did all so teach; so that high men of this land, that of their blood came, retain all the same speech that they of them took."

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[*] Koopen is to buy, in Flemish.

[†] Camden's "Britannia."

[*] This was a secret mission despatched by John in 1213.

But during the last fifty years of the fourteenth century, the French language rapidly lost the ascendancy it had held among us from the middle of the tenth, and became among all classes in England a foreign tongue.

Lewis Beaumout, Bishop of Durham, 1317, understood not a word of either Latin or English. In reading the bull of his appointment, which he had been taught to spell for several days before, he stumbled upon the word *metropolitice*, which he in vain endeavoured to pronounce; and, having hammered over it a considerable time, at last cried out, in his mother tongue—

"*Seit pour dite! Par Seynt Lowys, il ne fu pas curteis qui ceste parole ici escrit.*"*

The first instance of the English language, which has been discovered in the parliamentary proceedings, occurs in a petition of the mercers of London in 1388. Ten years after, is found the confession of Thomas, Duke of Gloucester.

The oldest English instrument produced by Rymer, is dated 1368; but an indenture, in the same idiom, betwixt the abbot and convent of Whitby and Robert the son of John Bustard, dated at York in 1343, is the earliest known.

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INORGANIC CHEMISTRY.

CLASS VI.—NOBLE METALS,

WHOSE OXIDES ARE PRODUCED BY HEAT ALONE.

XLIX. MERCURY.

Equivalent, 101·26. *Symbol*, Hg (*Hydrargyrum*). *Density*, 13·5.

THIS is the only metal which is fluid at ordinary temperatures. It is found as native or running mercury in Spain and Carniola, and also as cinnabar or sulphuret of mercury, but it is a rather rare and costly metal. The alchemists supposed it to be silver enchanted (*quick-silver*), and made many efforts to obtain from it the solid silver it was supposed to contain.

Pure mercury is a silver-white, fluid metal, unchanged by air, and very brilliant. Cooled below 40°, as when frozen by carbonic acid, it solidifies, and is then as malleable as lead. It crystallizes at this degree of cold in cubes. It boils at 660°, and forms a colourless, very dense vapour. Even at 60°, a very rare vapour of metallic mercury (129) rises from it. If heated in the air at above 600°, it slowly passes to the condition of red oxide of mercury, which is its highest combination with oxygen.

The uses of mercury are numerous and important in the arts, and also in medicine. It forms alloys (amalgams) with many other metals; with tin it constitutes the brilliant coating of glass-mirrors (called silvering), and it is of indispensable importance in procuring gold and silver from their ores. Its use in filling thermometers and barometers has already been described.

Nitric acid dissolves mercury very rapidly even in the cold; hydrochloric acid scarcely acts on it, and sulphuric only by the aid of heat, when it forms an insoluble sulphate of mercury, evolving sulphurous acid. The equivalent of mercury is often stated at 202·52, on the supposition that the gray oxide is the protoxide; but this seems to be more properly considered as a suboxide, and the real protoxide as the red oxide. On this view the equivalent is stated at 101·26.

Mercury may be so finely divided as to lose its metallic appearance entirely; as in *blue pill*, mercurialized chalk (*creta cum hydrargyro*), and mercurial ointment, which do not, as has sometimes been stated, contain the suboxide of mercury, but only mercury in a state of very minute mechanical division.

The Gray, or Suboxide of Mercury, Hg_2O, is formed by digesting calomel in caustic potash, or by adding the same re-agent to a solution of the nitrate of the suboxide of mercury. It is an insoluble, dark gray powder, which is easily decomposed into metallic mercury and the red oxide.

The Red Oxide, or Protoxide, Red Precipitate, HgO, is prepared in the large way by heating the nitrate very cautiously, until it is quite decomposed, and a brilliant red crystalline powder is left. It may also be formed by heating metallic mercury for a long time in a glass vessel nearly closed, and, in this form, is the preparation to which the old name of *red precipitate per se* was applied. Heat decomposes this oxide into oxygen and metallic mercury. It is, like the oxide of lead, slightly soluble in water, and gives to it an alkaline reaction. It is a dangerous corrosive poison.

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* "Take it as said! By St. Lewis, he was not very civil who wrote this word here."

The Chlorides of Mercury correspond to the oxides, and are both very important compounds.

(1.) *The Subchloride of Mercury* (*Calomel*), Hg_2Cl, is a well-known medicine, and is easily formed by precipitating a solution of subnitrate with common salt. A white, insoluble, tasteless powder falls, which is the calomel. Even strong acids, when cold, do not affect it; but it is instantly decomposed by alkalies and the suboxide produced. Heat sublimes it unchanged. Its complete insolubility at once distinguishes this safe and mild substance from the highly poisonous—

(2.) *Corrosive Sublimate, or Chloride of Mercury*, $HgCl$.—This salt is most economically prepared by the double decomposition of sulphate of mercury, by common salt; which, by simple interchange, gives corrosive sublimate and sulphate of soda ($HgO,\ SO_3 + NaCl = HgCl + NaO,SO_3$). The chloride is also formed by dissolving the red precipitate in hot chlorohydric acid. *Corrosive Sublimate* is a very heavy crystalline body, soluble in about 15 parts of cold water, and in two or three parts of hot, giving a solution which possesses the most distressing and nauseous metallic taste, and is a deadly poison. It is soluble in alcohol and ether. It melts and sublimes a little below 600°. Albumen completely precipitates it, and the whites of eggs are therefore an antidote for this poison. For the same reason it is, doubtless, that timber and animal substances are preserved from decay, as in the *kyanizing* process, by steeping in solution of corrosive sublimate. The albuminous portions of wood suffer decay sooner than the vegetable fibre, and these are rendered completely indestructible in the process of Mr. Kyan.

There are two iodides of Mercury, Hg_2I and HgI.—The second is a brilliant scarlet-red precipitate, formed by adding solution of iodide of potassium, or hydriodic acid to a solution of corrosive sublimate. The iodide is at first yellow, but soon passes by a molecular change into the splendid scarlet crystalline powder before noticed. It cannot be used as a pigment on account of its instability.

Two Sulphurets of Mercury, Hg_2S and HgS, exist, the first of which is formed when sulphureted hydrogen is passed through a solution of subnitrate of mercury, and is a black powder. The sulphuret, HgS, or cinnabar, is formed when the *nitrate* of mercury (nitrate of the red oxide) is treated with sulphureted hydrogen. It is a black precipitate, but turns red when sublimed, and forms the familiar pigment *vermillion*. This is the common ore of the quick-silver mines.

The Nitrates of Mercury.—The action of nitric acid on mercury varies with the temperature and the strength of the acid. In the cold, dilute nitric acid dissolves mercury, forming a neutral *nitrate of the suboxide*; but if the mercury is in excess, a salt is deposited in large and transparent white crystals, which is a nitrate with excess of base. If hot and strong, *the nitrate of the red oxide* is formed, which is a very soluble salt not crystallizable. A basic salt of this oxide may also be formed, which is decomposed by water.

Sulphate of Mercury ($HgO\ SO_3$) results as an insoluble, white, subcrystalline powder, by the action of the strong acid on metallic mercury, sulphurous acid being evolved. Boiling water decomposes this salt, removing a part of its acid, by which a yellow basic sulphate is formed, known as *turpeth mineral*. Its composition is $3HgO,\ SO_3$. The sulphate of the gray oxide, $Hg_2O,\ SO_3$, is formed as a crystalline white powder by treating a solution of subnitrate of mercury with sulphuric acid. It is slightly soluble in water.

Ammonia produces many interesting compounds with the salts of mercury, of which the *white precipitate*, as it is called, is best known. This falls when chloride of mercury in solution is treated with ammonia in excess, and is considered as a double amide and chloride of mercury, $HgCl$ and $HgNH_2$.

All the compounds of mercury are volatile at a red heat; and those which are soluble whiten a slip of clean copper by depositing metallic mercury on its surface.

L. SILVER.

Equivalent, 108·12. *Symbol*, Ag (*Argentum*). *Density*, 10·5.

The mines of Mexico and the Southern Andes furnish most of the silver of commerce, although many mines of this metal are found in Spain, Saxony, and the Hartz mountains. Galena, or the native sulphuret of lead, is also a constant source of silver, as it is rarely quite free from this precious metal. Silver is often found native, and also in combination with sulphur.

The brilliant lustre and white colour of this valuable metal are familiar to all. It is perfectly ductile and malleable, and in hardness stands between gold and copper. For the purposes of economy and in coinage it is essential to alloy it with about $\frac{1}{10}$ part of copper, to render it sufficiently stiff and hard. Pure silver melts at 1873°, and when melted absorbs several times its volume of oxygen gas, which it parts with again on cooling. This renders silver a difficult metal to cast, and occasions the little projections and roughness usually seen on silver which has been melted.

Silver is obtained pure from its solution in nitric acid by precipitation with metallic copper, as a finely-divided crystalline powder; or by decomposing its chloride by fusion with two parts of dry carbonate of potash. Nitric acid dissolves silver in the cold with great rapidity; and, if it contains any gold, this is left undissolved as a brown powder.

Hydrochloric acid scarcely acts on silver, and sulphuric acid only when hot, forming the sulphate of silver, which is sparingly soluble in water.

Silver is parted from galena, by a process called *cupellation*, or fusing at a white heat the pulverized galena and a certain quantity of metallic lead, on a little thick cup or cupel of bone-ashes, in a muffle exposed to a current of air. The lead oxidizes and is absorbed, while the silver is left in a brilliant metallic button on the cupel. In the large way, this process is much facilitated by the fact that the alloy of silver and lead is more fusible than pure lead, and the latter on cooling separates from the former, which may be drawn off, and contains all the silver. This small portion is cupelled, while the great bulk of the lead is returned to the arts uninjured.

Three oxides of silver are known by chemists: the suboxide, Ag_2O; the protoxide, AgO; and the peroxide, AgO_2. We will now notice only the protoxide. This is formed when the solution of silver in nitric acid is saturated with caustic potash, or when the chloride of silver recently precipitated is digested in a solution of caustic potash of density 1·3. It is a dark brown or black powder, if prepared by the first mode, or quite black and dense, by the second process. It is a base, forming well-defined salts. Ammonia dissolves it readily, and it is also somewhat soluble in water, to which it gives an alkaline reaction. It is easily reduced by heat alone. Its solutions are at once detected by the bulky white curdy precipitate which they form with hydrochloric acid or with common salt. This white precipitate turns dark by exposure to light.

Chloride of Silver, $AgCl$, is formed, as just remarked, when any subtle salt of silver is treated with a soluble chloride or with hydrochloric acid. This substance fuses at a moderate red heat into a transparent pale yellow fluid, which is horny and tough when solid, and hence called *horn silver*—a form in which this metal is sometimes found in mines. It is easily reduced to the metallic state by the nascent hydrogen generated when zinc is acted on by dilute sulphuric acid in contact with the chloride. Pure silver and chloride of zinc result; or it may be reduced by fusion with twice its weight of carbonate of soda or potash.

The iodide and bromide of silver are, like the chloride, insoluble in in water, and very sensitive to light. The Daguerreotype and calotype are both dependent on the sensitiveness of these compounds to light, for the accuracy and beauty of their results.

The sulphurets of silver are found native; and the tarnish which blackens silver articles on long exposure, is formed by sulphureted hydrogen in the air.

The Nitrate of Silver, AgO, NO_5, is a salt which crystallizes in beautiful flattened tables of a hexagonal form, which dissolve in half their weight of hot water. By heat it fuses, and when cast in cylindrical moulds, forms the slender sticks called *lunar caustic*, so much used by the surgeon. Its solution has a disgusting metallic taste even when very dilute, and is a most delicate test of the presence of chlorine or any of its compounds. It blackens rapidly in contact with organic matter when exposed to the light, and forms an indelible ink, which is much used in marking linen. Solution of cyanide of potassium will remove the stain produced by nitrate of silver. Metallic copper at once throws down metallic silver from the nitrate, and solution of nitrate of copper is formed. Mercury precipitates metallic silver from a dilute solution, in beautiful tree-like forms, called *arbor Dianæ*. Ammonia, by acting on precipitate oxide of silver, forms a fulminating compound. It is extremely hazardous to deal with, as it explodes even when wet.

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THE STUDY OF CHEMISTRY WITH THE BLOWPIPE.—No. IV.

TO DETECT THE PRESENCE OF THE EARTHS.

Barytes alone does not fuse until it has absorbed a little water. The hydrate fuses, bubbles, intermixes, and at last solidifies at the surface, after which it penetrates, with a brisk bubbling, into the mass of the charcoal, where it loses the water it contains, and becomes a solid crust.

With borax it fuses readily with effervescence into a clear glass.

With salt of phosphorus it fuses, effervescing and swelling up during the process. A transparent glass is found when the intumescence subsides.

Strontites alone presents the same phenomena as barytes; and with borax and the salt of phosphorus its characters are also similar. The carbonates of these bodies, on being heated, have an alkaline re-agency. The caustic earth presents its alkaline characters when the carbonic acid is driven off. This is the cause of the effect we have mentioned.

Lime, if caustic, is unchanged by heat. The carbonate becomes caustic, emitting a brilliant white light. When moistened, it falls into powder. With the salt of phosphorus, lime fuses into a clear glass, retaining its transparency when cold.

Magnesia alone does not change under the blowpipe, and it has no alkaline re-agency.

Alumina is also infusible. Berzelius recommends the nitrate of cobalt as the most effective re-agent for distinguishing between alumina and magnesia. Alumina, after strong ignition, gives a fine blue with the oxide of cobalt; magnesia a pale rose colour. The nitrated oxide dissolved in water is the preparation generally used. There are two ways of treating a substance with the nitrate of cobalt, described by Berzelius:—

"If the assay be absorbent, a small grain of it is used, which is to be moistened with a drop of the solution, and heated strongly, but not fused. After being heated some time, the assay becomes of a blue colour (more or less pure), if it contain alumina; and red, or rose colour, if magnesia.

"In the latter case we must endeavour to fuse it; for the magnesian compound retains its red colour after fusion, and generally acquires a stronger tint. The blue colour of the alumina is also permanent in fusion, but it thereby loses its distinguishing character; for minerals which contain lime or alkali, without alumina, also become blue by fusion with the oxide of cobalt; but not till they have been fused.

"For harder substances, such as the crystallized stones, the process is different. The stone is to be ground with water in an agate mortar till reduced to the state of pap. A drop is to be taken up and laid on charcoal, which will absorb the water, whilst the fine powder suspended in it will remain on the surface. To this we add a drop of the solution of cobalt, and heat it gradually to redness, without stopping to examine the successive tints it passes through before the salt is decomposed, and which end in black; for it is not till the moment of brightest incandescence that the characteristic action is developed. When the mass begins to detach itself from the charcoal, we may take it up carefully with the platina forceps, and exposing it in that state to the flame of the blowpipe, heat it more easily to the degree required.

"The colour of the assay cannot be judged of till it is completely cold, and it must be examined in daylight. The finest blue appears of a dirty violet colour, or almost red, by the light of a lamp or candle."

Silica is a very refractory substance. Alone, it undergoes no change under the blowpipe. With borax, it fuses slowly, and with difficulty, into a clear glass. Salt of phosphorus dissolves a very small proportion of silica; but the compound is transparent when cold, and the unfused portion is semi-transparent. With soda, it fuses into a clear glass, the process being carried on with a brisk effervescence.

It is not necessary, in a merely elementary sketch, to describe the phenomena presented by the metallic oxides, when acted upon by different re-agents. There is, however, one operation of a delicate character, which cannot be passed over without notice; it is called cupellation, and consists in the separation of a noble metal from scoriæ and other impurities.

Bone ashes (phosphate of lime) reduced to a very fine powder, are required to form the cupel, and lead free from alloy, especially from silver. After having cut a small hole in the charcoal, as before described, take on the point of a penknife some of the finely-pulverised bone ashes, and knead them in the palm of the hand to a thick paste. Add a little soda, if necessary, to give it a sufficient degree of cohesion. When the paste has been placed in the little hole made in the charcoal and smoothed, heat it gradually under the flame of the blowpipe, until it is perfectly dry. When the assay has been fused with pure lead, it is placed in the middle of the little cupel, and heated at the extremity of the flame. After this operation is finished, the precious metals will be found on the surface of the cupel, while the scoriæ and impurities will have passed through with the lead. "This experiment," says Berzelius, "is so delicate, that grains of silver visible to the naked eye, and, indeed, such as may be collected by the forceps, and extended under the hammer, may, in this way, be extracted from the lead met with in commerce."

To attempt a description of the pyrognostic characters of minerals, would far exceed the limits necessarily assigned to this essay. But, without entering into any minute particulars, one or two of the gems with which the reader may be supposed to be acquainted, will give the opportunity of illustrating the mode of experiment, and the deductions drawn from the phenomena they exhibit.

The Diamond is, commercially speaking, the most valuable of all minerals; but the only thing, for which it is really valuable, is its extreme hardness. By the blowpipe it is reduced to a mass of charcoal. To effect this change, some skill is required, and, to succeed in the experiment, a very small fragment should be selected, and a good blast, producing a strong heat, must be kept up for a considerable time.

Topaz does not fuse on charcoal. The yellow topaz, when brought to a state of low ignition, takes a pale rose-colour. This is occasioned by the conversion of the hydrate of iron into the peroxide. With borax, topaz fuses slowly into a transparent glass. The limpid topaz becomes white and opaque before its solution. With a little soda it is converted into a colourless, semi-transparent scoria, but not easily. With a larger quantity it swells up, and becomes infusible. With salt of phosphorus it is slowly dissolved, leaving a skeleton of silica. The globule is transparent, becoming opaline on cooling.

Garnet fuses on charcoal, without intumescence, into a black globule, with here and there an appearance of reduced iron on the surface. This globule, when saturated with borax, takes the colour of amethyst; soda decomposes it. With a small quantity it fuses into a black globule; but, as the quantity of soda is increased, the fusibility is lessened, and at last is entirely destroyed. On platina foil it gives distinct traces of manganese.

Emerald fuses with borax into a transparent, colourless glass. The chrome-green emerald produces a glass which assumes a light green tinge on cooling. With soda it fuses into a transparent, colourless glass. The yellowish emerald, from Broddbo and Finbo, gives distinct traces of tin in the reducing flame. With salt of phosphorus it dissolves slowly without any siliceous residuum. The assay visibly diminishes in size for a time, and then fuses into a globule, which becomes opaline on cooling. The chrome-green emerald gives a green glass.

It would be useless to multiply examples. Practice and observation will enlarge the boundary of the student's knowledge, and give him permanent possession of the facts he acquires by reading. His first object will be to acquaint himself with the appearances assumed by the elementary substances under the blowpipe—alone, and when treated with fluxes. He will next accustom himself to the detection of acids by operating upon substances of known composition. Having obtained some degree of expertness in the use of his instruments, and much elementary knowledge, he may attempt the analysis of minerals whose components, and their proportionate admixture, are well determined. This will, for a time, be difficult, and many of his attempts will fail of success ; but the time and labour will not be lost while he is acquiring the habit of observing the slightest differences of appearance, and of referring them to their proper source. If, at any time, the task of learning be tiresome and laborious, there will always be the pleasing thought that the labour is expended for an inexhaustible fund of amusement and useful information.

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INDUSTRIAL EDUCATION.

This is a branch of practical education which is daily forcing itself more and more on public attention; and the time is rapidly advancing when the government of the country must see the necessity of carrying some organized system, on a grand national scale, into general operation. By the term "educated classes," says an intelligent writer (Mr. W. B. Adams), we are too apt to consider those only who can "read and write and cast accounts," and possess such other knowledge as may grow out of these primary elements,—which are not knowledge, but simply the tools of knowledge, and by no means comprise that education which is essential to independence in life; as witness the hordes of educated people in Australia, who have left an unsatisfactory condition of existence here for a still more unsatisfactory state there. By education we must understand, first, the power of self-maintenance ; and, next, that general amount of knowledge of "men and things" which will enable each one to discover and attain the position for which he or she may be best fitted, in which they may cultivate the whole of those natural aptitudes.

Writers on political economy have mostly laid great stress on the mutual advantage arising from a "division of labour." Now, although it is quite true that Robinson Crusoe produced a less proportionate amount of material result, by doing all things himself, than a hundred Robinson Crusoes would have done by doing one thing only, yet the individual Robinson Crusoe was, upon the whole, much more of a complete man than the individuals of the hundred would have been.

Our existing system makes shoemakers, or fractions of shoemakers, in subdivision; fractions of carpenters, fractions of agriculturists, weavers and fractions of weavers; but it does not make *men*. Our "Universities" are anything but universal; they profess to endow students with the circle of the abstract sciences, but they leave man himself as an abstraction. It is thus by a chapter of accidents that the right man gets to the right position ; and it is difficult to predicate from the youth what he will become in manhood.

Education, in the best sense, is that in which the mind and body advance by equal steps; and, in the education of the children of the State, this is more likely to be accomplished than in already existing establishments. The County School should be an Industrial University for the world's work, in which the students would earn their maintenance while acquiring a knowledge of the means. By merely giving these facilities, boys would learn from seven to fourteen all that they now acquire from fourteen to twenty-one. They would learn it as an amusement, a play, and not as a drudgery. Such a University would be a town in miniature. The students would perform every kind of labour essential to the maintenance and enjoyment of their existence. First would come the arts of gardening and agriculture, and dairy and sheep farming, with practical digging, ploughing, planting, milking, shearing, &c. These would be out-door classes. Analogous to these, would be classes in-doors giving instruction in the mechanism of gardening and agriculture; and pointing out the processes whereby hand-tools could become machine-tools, and how the other powers of nature might best be substituted for animal power. There would also be chemical classes teaching how to analyse soil and climate, and to experiment upon the processes whereby vegetables may be improved for man's food, so as to become *quasi* animal food, and solve the problem how we may best escape from the humiliating process of slaughtering the inferior animals, and entombing them in our stomachs.

Next to the production of food would come the classes studying the preservation of food—giving a large scope for mechanical and chemical improvement. How economically to preserve grain and vegetables and animal or animalized substances in large quantities, so as to be independent of seasons of dearth, and with the least possible waste and destruction, is an important problem.

The next consideration is clothing. Leaving out of consideration the preparation of material—though that, also, is a fitting subject—there are shoes, stockings, and linen and cotton inner and outer clothing, and coverings for the head. Cutting out shoes and sewing or otherwise putting them together—cutting out clothes and putting them together—would furnish employment for the work-rooms.

Independently of these practical classes, there should be other classes in which the principles of human clothing should be taught, pointing out to the students the path of progress. How to cover the body so as to exclude wet, and cold, and heat, without interfering with the natural exhalations or free movement of the limbs, with the minimum cost of labour, would be a very fitting problem to solve.

Whether it be practicable to improve our vegetable productions so as to be independent of the skins or hair, fur, or exudations of animals, for our clothing, is another question well worth serious reflection, when a deficiency of wool drives our manufacturers to the use of "shoddy," or old clothing, the materials of which are fitted for paper rather than cloth. There is also a larger scope for the improvement of floor-covers, and of nocturnal clothing while sleeping, and the whole arrangement of beds or couches, so as best to maintain warmth, while effectually providing for the escape of bodily exhalations.

Another question is of light, fuel, and warmth—after "meat and clothes," fire. The preparation of fire-wood and matches, and various kinds of artificial fuel, might occupy practical classes, as well as gas or other works for the supply of light to the establishment. The in-door classes would teach the chemical questions of light and heat; the chemical properties of the coal used for producing gas, and heating retorts, and preventing the production of smoke; the chemical treatment of the refuse, for manure or other purposes; the best arrangements for instantaneous light without deleterious manufacture; the respective advantages of coke and gas fuel; and the possibility of new forms of fuel and light.

The next consideration is of buildings, dwellings, and workshops. The making of bricks or artificial stone, preparation of slate, and various wood and iron work, together with drainage and erections, are all processes for the practical classes. For the theoretical classes there are the general purposes of building, durability of material, and shelter and warmth with light and ventilation, and baths. How best to make the buildings fire-proof; how to make the walls homogeneous, impervious, and yet not too heavy; how to make the roof most durable; how best to manufacture warm air to maintain a healthy warmth in the building; how best to supply radiant heat, and how to get rid of mephitic air; how to regulate dryness and moisture—are all matters to be pointed out by the teacher as the scope and objects for improvement.

It is thus essential that students should behold the whole circle of the useful arts; and, for the promotion of their practical studies in every sphere of industrial education, we are not acquainted with any work more desirable than "ORR'S CIRCLE OF THE SCIENCES," now on the eve of publication.

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SCHOOLMASTERS' MEMORIAL.

A MEMORIAL from the elementary teachers of Church of England schools, with upwards of 600 signatures attached, has just been presented to the Committee of Council on Education, which states that "both with regard to their examinations for certificates of merit, and also with regard to the examinations of pupil teachers, the great number of existing text books on each subject, the absence of an authorised list, and the want of a classification of subjects, produce much uncertainty in their plans of study, and conduce to that general superficiality of attainment of which her Majesty's inspectors have so frequently complained." The memorialists then proceed to express an earnest desire that their Lordships would grant a list of text books, and some such classification of subjects as that suggested by Professor Mosely in his reports for 1848 and 1851. They then state their belief that many able teachers are induced to leave the profession, as at present they have no prospect of suitable promotion for lengthened services and the most successful exertions; and they further believe that men connected practically with the work of education, are capable of accurately testing its character and results. They consider that the opening of such a field of promotion to the deserving and efficient teacher would retain in the profession much valuable aid, and be an incentive to fresh exertion on the part of all.

"There are many facilities (says the memorial) for the schoolmaster's obtaining aid in case of sickness, and relief for his widow and orphans at his death; but no assurance office allows him that rate of interest which, according to his ascertained shortness of life, the memorialists believe he is entitled to expect. The Rev. Professor Moseley has advised that a superannuation fund should be created for aged teachers, and your memorialists would venture to add their earnest entreaties to his valuable and disinterested suggestions; but they would, at the same time, respectfully invite your attention to the fact, that whilst the number of certificated teachers bears so small a proportion to the uncertificated, it would be apparently a hardship to deprive those who lived in less favoured times, and many of whom rank amongst the most successful teachers, of the advantages such a fund would secure."

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JUVENILE LITERATURE.

During the last quarter of a century, juvenile literature has made more rapid progress than perhaps any other branch of the publishing trade. The men of the last century had their Hume, Gibbon, and Robertson,—their Fielding, Smollet, and Richardson; but, if we except the never-forgotten "Robinson Crusoe," and the "Pilgrim's Progress," children had no books written for them worthy of mention. What did our great writers do for the mental nourishment of the young and growing intelligence of the country? With the exception of Mrs. Barbauld and Miss Edgeworth, who belong almost to our own day, very little had been accomplished in juvenile literature down to within the last dozen years. A reaction, however, was at length destined to take place. Some distinguished writers added to the stories of child literature, both in England and Germany. One of the finest books we know of for a child was written by the German philosopher, Carové, called "The Story without an End," and admirably translated by Mrs. Austin. This book is a beautiful picture of an infant soul living in the bosom of nature; and what can be better for a child than that? Then there came Hans Christian Andersen with his beautiful child's stories; and at home there was Mary Howitt, and Harriet Myrtle (Mary Gillies); the brothers Mayhew, Aunt Effie, Mrs. Harvey, and many more; and the art with which these modern children's books are illustrated is the most remarkable thing of all.

A new feeling has also been thrown into the child's literature of the last few years by modern writers and artists. In no respect is the progress of the age more striking than in this apparently trifling matter. The old Wolf and Lion Stories, with griffins, salamanders, and one-eyed ogres, have given place to a style of literature much more true, more wholesome, and more instructive. The fancy is fed, while the understanding is not neglected. Imaginary young ladies are no longer fallen in love with by impossible princes; but we have, instead, pictures often full of true pathos,—novels in little of the world as it is,—touched often with a picturesque and dramatic truthfulness which appeals even less to the fancy than to the sympathies and reason of their young readers. And it is a great work in which the writers of these children's books are engaged—no less than the moral and mental training of the women and men of the next and succeeding generations, as well as the formation of what is called *national character*.

EDUCATIONAL AND SCHOLASTIC MATTERS.

EDUCATION OF LADIES.

The time is at length approaching, when the education of ladies must no longer be neglected or abused as it has hitherto been. Every lady engaged in tuition will, ere long, be probably called upon to undergo a searching examination, and be obliged to take out a certificate of qualification; as the College of Preceptors has embraced, in the bosom of its contemplated educational reforms and improvements, the ladies also, as well as the men. They have lately sent an important circular to all the qualified principals of ladies' schools, and governesses in the British empire, recommending the principle of compulsory examination for all persons entering upon the profession of teacher; by which every candidate, without exception, will be required to produce satisfactory testimonials as to their previous habits and occupations. The higher examinations will comprise twelve subjects, in all or any of which, candidates may obtain certificates according to the degree of their proficiency. A fee of half-a-guinea is to be charged for all the certificates required in *each grade* of eight subjects; so that, there being *three* grades, the total expense for certificates cannot, in any case, exceed one guinea and a half. A Diploma involves somewhat higher charges. Ladies engaged in tuition previously to the date of the Charter, are to be admitted by election.

WORCESTER SCHOOL OF DESIGN, AND THE EDUCATION OF FEMALES.

At the second annual meeting of this institution, held at the Music Hall, Worcester, a very satisfactory report was read, which stated that, during the past year, no fewer than 278 students had received instruction; 229 was the largest number that had attended in any one month; and 192 was the average monthly attendance; being an increase over the first year of forty students in regular attendance. The revenue for the year, including the Government grant of £150, was £720 6s. 7d., and the expenditure £570 2s. 10d.—balance, £150 3s. 9d. During the discussion which followed, Mr. Cole stated that it had been a subject of discussion as to the propriety of admitting females to the school. There was hardly a more important object contemplated by the Government Department of Art than that of the education of females. By a kind of barbarity and selfishness among the lords of creation, women had been excluded from a source of profitable employment, which ought to have been, and might have been, most appropriately assigned to them. He alluded to the selfish jealousy which pervaded the Staffordshire potteries against the introduction of women into the porcelain trade.

ORPHAN WORKING SCHOOL, HAVERSTOCK HILL.

The history of this school, from its first establishment in 1758, to its location at Haverstock Hill, in 1847, presents some interesting features. It was originally commenced at a small house in Hoxton, for the reception of twenty poor orphan and destitute boys, and was one of the earliest institutions of the kind in the kingdom. In the course of a few years, twenty girls were also admitted, making a total of forty children; this number gradually increased, until a second and third house were full, when a piece of ground was purchased in the City Road (then a suburb of London), where the building was erected in 1775, which was, until within the last few years, occupied by the children. The school in the City Road was intended for thirty-five boys and thirty-five girls; but in 1842 that number had increased to one hundred, and in 1846 to one hundred and thirty-nine. In anticipation of the falling-in of the leases in the City Road, which would greatly benefit the charity, it was determined to erect a new building, where two hundred and forty children could be accommodated. Haverstock Hill was the spot selected in 1847. The one hundred and thirty-nine children soon became two hundred and sixty-five. The total increase for the last ten years has been one hundred and fifty-two, or at the rate of fifteen per annum, during that period. Altogether, one thousand five hundred and eighty-one poor children have been admitted into the schools. Most of those who have left, after receiving a religious, useful, and suitable education, have been placed in situations, in which they have, by industry and good conduct, obtained a comfortable livelihood. Some have risen to influential stations in society, and many of them are now governors of the charity.

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THE FAMILY TUTOR.

Our next Number, which will be published on the First of January, will complete the Sixth Volume of The Family Tutor, and be accompanied with the usual Title-page, Preface, and Index.

With the present number of The Family Tutor we have the satisfaction of issuing another sheet of the important work on "British Plants and Structural Botany."

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NATURAL PHILOSOPHY.

Second Division.

CHAPTER LIV.

HYGROMETRY, OR THE MEASUREMENT OF THE QUANTITY OF VAPOUR.

Hygrometers—Sponge and Paper Hygrometers—Saussure's Hair Hygrometer—Mode of Graduating it—The Dew Point—Process for the Dew Point—Daniel's Hygrometer—The Psychrometer—Process for Drying Gas.

For many scientific purposes it is often necessary to determine the amount of vapour of water in the air or in various gases. We have already observed (Chapter III), that the quantity of moisture in the atmosphere is constantly changing; and this is connected with a great number of interesting meteorological phenomena.

Instruments have been invented with a view of giving indications of the relative degrees of dampness of the air. They have received the names of hygroscopes and hygrometers.

A great many organic substances change their dimensions according as they are exposed to various degrees of moisture, expanding or contracting. Among such may be mentioned ivory, hair, whalebone, wood, &c. Any of these, connected with a mechanism by which the change of volume might be registered, would furnish a hygrometer. They all, however, lose their sensitiveness in the course of time. Thus it is well known that wood, when it is seasoned, is much less liable to these changes than when it is in a recent state.

There are other bodies, among which might be enumerated many salts, which, by absorbing moisture from the air, increase in weight, and by returning it back again becomes lighter. Most of the powerful acids, as the sulphuric, also the alkalies, as potash and soda, possess an intense affinity for water. Advantage has been taken of this property in the construction of hygrometers, by attaching a sponge, soaked in weak pearlash, to one arm of a balance, the index of which plays over a graduated scale, and shows the influence of the existing moisture by the sponge becoming heavier or lighter, as in Fig. 316. For such contrivances, paper is a very suitable substance. Thus, let G G, Fig. 317, be a case, the front of which is of glass, and the sides of gauze or some other material, pervious to the air; let D be the beam of a light balance suspended within, working on the fulcrum G, and supported by two

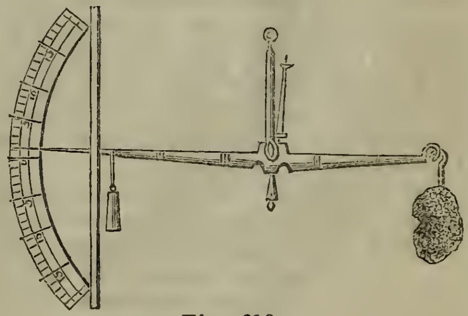

Fig. 316.

brackets, AA. From the beam let there pass an index, E, which moves over a scale, C, graduated into 100 equal parts, and suspended on a support, B. From one end of the beam let there hang the hygroscopic body, I, which consists of a great number of round pieces of thin paper, fastened together by three or more threads forming a column, with spaces, between each of the parallel pieces of paper, that the air may have complete access to the whole mass. This hygroscopic body is properly counterpoised by a weight, H, in the opposite scale-pan. At F there is a button, which slides upon the index: it is to be arranged in such a position that a weight of one grain put on the top of the hygroscopic body will drive the index from 0 to 100 exactly. The papers are now to be thoroughly dried by placing a dish of sulphuric acid in the case, or in any other suitable manner; and when that is accomplished, weights are to be added at H to bring the index to 0. When now it is exposed to the air the papers become heavier, and the index plays over the scale. The instrument, therefore, acts from the dry extreme; but though its movements are interesting, for it is constantly traversing, it is devoid of exactitude.

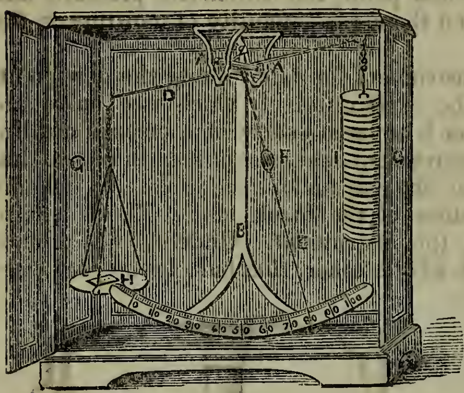

Fig. 317.

The hair hygrometer of Saussure is more simple and effectual. It consists of a human hair 8 or 10 inches long, *b c*, Fig. 318, fastened at one extremity to a screw, *a*, and at the other passing over a pulley, *c*, being strained tight by a silk thread and weight, *d*. From the pulley there goes an index which plays over the graduated scale *e e′*, so that, as the pulley turns through the shortening or lengthening of the hair, the index moves. The instrument is graduated to correspond with others by first placing it under a bell jar along with a dish of sulphuric acid, caustic potash, chloride of calcium, or other substance having an intense affinity for water; this absorbs all the moisture of the air in the bell, and brings it to absolute dryness. The hair, therefore, contracts and moves the pulley and its index. When this contraction is complete, the point at which the index stands is marked 0. The hygrometer is then placed under a jar, the interior of which is thoroughly moistened with water and set in a vessel with that liquid, so as to bring the included air to a condition saturated with moisture. The index moves, and when it has become stationary the point opposite to which it stands is marked 100°. The intervening space is then divided into 100 equal parts, and the instrument is complete.

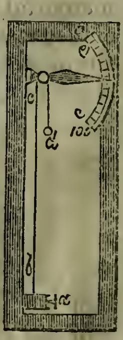

Fig. 318.

It is to be observed that the hair requires some previous preparation to give it its full hygrometric sensibility; this is accomplished by removing from it all oily matter by soaking it in a weak solution of potash.

As respects the nature of the indications of this instrument, it is to be understood that it by no means follows that, when the index stands at 25 or 50, the air contains one quarter or one half the moisture it does at 100. Tables have, however, been constructed, which exhibit the value of its degrees.

A much more exact method is that known as *the process for the dew point*. In practice it is very simple, and may be thus described. If we take a glass of water and, by putting in it pieces of ice, cool it down, after a time moisture will begin to dim the outside. If a thermometer is immersed in the water, we may determine the precise degree at which this deposit takes place; and, knowing the temperature of the external air for the time being, we can tell the number of degrees through which it must be cooled before the dew point (or the point at which moisture deposits) is reached. Now, when the air is very moist, it is necessary to cool it very little before this effect ensues;

but when it is dry, the cooling must be carried to a correspondingly lower degree. If the air were perfectly saturated, the slightest depression of temperature would make the moisture precipitate. Knowing, therefore, the dew point, the barometric pressure, and the existing temperature, if it is required to find the actual quantity of moisture in the air, it can be determined by calculation.

Daniel's hygrometer is a very beautiful instrument for determining the dew point. It consists of a bent tube, *a c b*, Fig 319, at the extremities of which two bulbs are blown; one is made of black glass, and the other is covered over with a piece of muslin. The black bulb is half full of ether, and the instrument-maker contrives things so that the rest of the tube is void of air, and contains the vapour of ether only. A delicate thermometer has its bulb dipping into the ether of the black bulb. There is also another thermometer attached to the stem of the instrument. Under these circumstances, if the muslin cover of *a* is moistened with a little ether, that bulb becomes at once cooled by the evaporation, the vapour within it condenses, and a fresh quantity distils over from the other to supply its place. But the black bulb cannot furnish the vapour without its own temperature descending; for latent heat is required before the vapour can form. After a time, therefore, through the cooling agency, dew begins to deposit on the black glass, and the point at which this takes place is determined by the included thermometer.

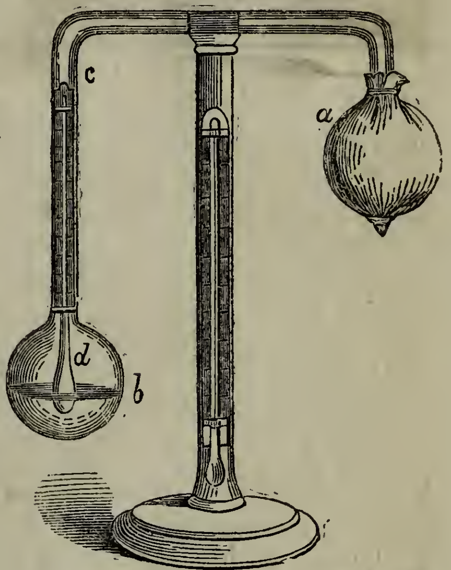

Fig. 319.

The *psychrometer* consists of two delicate mercurial thermometers divided into fractions of degrees, and corresponding perfectly with one another. The bulb of one of them, Fig. 320, is covered with muslin, that of the other is left naked. On the central pillar there is arranged a reservoir of distilled water, from which a thread passes to the muslin on one bulb, and keeps it constantly moist; as the water evaporates from this bulb the mercury begins to fall, and the drier the air, the greater the descent. As soon as the air round the bulb is saturated with moisture, the point at which the mercury stands is the dew point. If both thermometers, the damp and the dry, coincide, the air contains moisture at its maximum density, and the greater the difference between them, the drier the air.

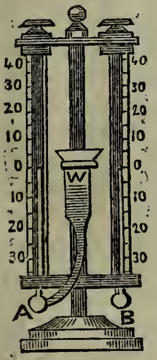

Fig. 320.

For many purposes in chemistry and physical science, it is necessary to remove all moisture from atmospheric air and from gases. This may be done by conducting them through tubes containing bodies which have a strong attraction for water. The bodies commonly selected for this purpose are chloride of calcium, hydrate of potash, phosphoric acid, and fragments of glass or quartz moistened with oil of vitriol. The process is as represented in Fig. 321, where *a* is the flask from which the gas to be dried is evolved, *b* a bent tube which conducts it into a wider tube, *c*, containing the absorbent material. It escapes from *d* in a dry state.

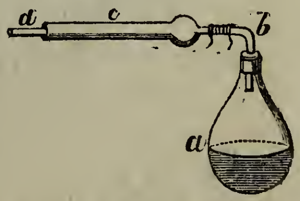

Fig. 321.

In the preceding articles we have entered upon most of the interesting subjects connected with "Natural Philosophy;" and we have only to regret that the limits of this volume do not permit us to introduce the important subject of "Magnetism and Electricity," for which our engravings had been prepared; but the article will, in all probability, appear in some future number of the "CIRCLE OF THE SCIENCES," with which THE FAMILY TUTOR will be incorporated.

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INSPECTORS OF PUBLIC SCHOOLS, AND THEIR DIFFICULTIES.

BY Inspectors of Schools we mean, officially speaking, her Majesty's Inspectors, acting under the orders of the Committee of Council on Education. There are, however, many other Inspectors of Schools appointed by ecclesiastical, or corporate, or lay, or mixed bodies, interested in the great work of Education; to whom alone the right of visiting a particular school may be conceded, even to the exclusion of those first named.

However numerous may be the advantages derivable from the visits of an official Inspector, or from a series of Inspectors, there is no doubt but they are a fertile source of difficulties with most of the teachers in our elementary schools; nay, that they are dreaded by numbers of them and hated by more. Yet, when teachers are really sincere and laborious, earnestly desiring to discharge the duties they have undertaken, as well as to improve themselves and the schools, there the Inspector should be regarded in the light of an enlightened teacher and experienced friend, who is able and willing to direct them in the right way.*

There are many sources whence discordant opinions and directions arise which may cause great perplexity to the teacher, and increase his difficulties upon such matters in a way which becomes occasionally very trying to his patience or skill. For instance—when opposite, or at least widely different views are taken on any subject by two Inspectors, who may be both equally authorized by the managers to examine the school, and, in certain places, to give suitable directions to their master; or when the Government officer differs from the diocesan, corporate, or local Inspector. The rapidly-increasing knowledge, however, of all the varied points connected with elementary education, and the enlarged experience upon the subject, which every year's duties must contribute to the observant Inspector, will of course develope new plans, in this particular or in that, which it is expedient to adopt, and which may accidentally be first suggested by one or the other of the inspectorial visitors.

With respect to the general EXAMINATION OF THE SCHOOL, when the inspectors make their appearance, they are greeted by garlands and smiling faces; when they take their leave, it is occasionally amid drooping flowers and dull faces. The line of examination has perhaps been pronounced unsatisfactory; the questions unfair and unusual; the lofty expectations of the inspector absurd; and his method of dealing with their school disheartening to the children, injurious to the committee, and destructive of the master's well-earned reputation; though, notwithstanding such hard speeches, it is evidently the necessary duty of the examining officer to forsake the beaten rut the scholars have been tramping, and to pursue the plan which in his own mind he thinks best, in order to learn, and to exhibit to all parties, the genuine unvarnished state of things. The fact is, both managers and teachers are apt to expect sometimes too much, at others too little, from the Inspector. Where it is fancied that his long-looked-for visit will be the signal for at once transmuting their school, now in ill-repute, into a good one; or that, by a touch of his magic wand, he can relieve their minds and labours and breeches-pockets of certain diminutive burdens; or, by some splendid device and influential nostrum, he will make up for the neglect of years, and for the miserable dregs of education which their narrow jealousy has been doling out to the children of the poor: there, expecting far too much, they are greatly disappointed to find nothing in the shape of panacea, save the old story about good systems and good instruments, liberality both in opinion and expenditure, watchfulness and perseverance, pains-taking, and a zealous co-operation of all parties. In other cases too little is looked for from the worthy official.

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* For many of the sentiments here expressed, we are indebted to a well-digested little work entitled, "A Schoolmaster's Difficulties," published by Longman.

Now an Inspector is but a mortal man, and cannot perform miracles, but must work by the old plan of "line and rule," which has guided many a wiser hand than his. He is also, it is to be hoped, an honest man, and though he may be skilful enough to detect every mischief exhibited before him, will not pretend to the knowledge of some specific, by which all evils may be at once and almost insensibly removed. His business is not to flatter the managers and the master, or to find a blooming garden where is rather a thorny waste, but to do his duty alike to the Government and to all parties concerned, without respect of persons, and without deceiving their hopes and imaginations, whether on this side or that. He can have no interest in promoting any delusion, and no motive for giving any annoyance. His errand is, to do what good he can by his visit; to render all the assistance in his power to managers and teachers in the work of education; to promote the best interests of the children of the poor; and to further the cause of truth. His duty is, to try and find out the true character of the school; what good it is doing, what is the nature of its machinery, the efficiency of its teacher, the cause of its present condition, &c. &c. His eagle-eyed experience will not be long in detecting every delusion, pretence and sham, whether purposed or unintentional, though for some time he may be only a silent spectator of what is going on; and, if a fair field be allowed him, he will not only banish the blots which are evident, but get all parties into hopeful working order, keep them up in that spirit, and push on their energies. Nothing but *realities* can satisfy him; and every attempt either to impede his operations, or to throw dust in his eyes, will only provoke his conviction that things are not what they seem.

Nothing is more unwelcome, not to say disgusting, to every straightforward spirit, than to discover that people are purposely misleading him by some humbug or ensnaring exhibition. A similar shock must be felt by an Inspector, when, upon an official visit, after having been somewhat talked down into silence, and bowed into certain places of honour and repose, allotted to him specially on the occasion of the spectacle, he observes (as he cannot fail to do) that the school is primed, loaded, and all ready to be shot off in his face, precisely at the day and hour specified. Notwithstanding his glum patience, and an evident uneasiness under the infliction, he is respectfully requested to witness the knowledge and cleverness of the children; and so there the good man sits, as—"shoot, fire, bang,"—volley after volley,—class after class,—he is compelled to see the wondrous fire or smoke, and to hear the rattling noise which has been for weeks in preparation for his particular benefit. The contrivers of the performance no doubt think it as right as it is grand, and look for their critical visitor to be slightly astonished; but alas! instead of admiring, he pities all parties, though he cannot help feeling contempt for the delusive trick as well as for the silly master, who is usually its chief engineer. Nevertheless he looks on, during his set time, with all the gravity and forbearance he can; learning meanwhile many a point in the character both of the school and its teacher, even through all the varnish which has been so carefully laid over the scene; but when at length he is let loose from his trammels, and permitted to proceed in earnest upon the only business that brought him hither, he soon proves, to all who care to be convinced, that what has been enacted is merely a sham and a show—that the poor children are really, at bottom, untaught, superficial, ignorant, ill-trained, and misdirected, and that the master himself, when fairly tried, turns out to be only a sorry fugleman, who has but little learning, tact, or experience. No wonder that, when opportunity is given him, he tells all parties, especially the master, a few unpalatable truths; or that, after having recommended such plans and changes as he thought would lead to improvement where it was so cryingly needed, he makes his bow with a sigh, hoping to find a better state of things in all departments next year.

The Examination of the Pupil-Teachers forms another great difficulty connected with the duties of public Inspectors. This cannot fail of being a very anxious time with most masters; and hence the difficulties they feel in anticipation of it and in connexion with it are, at least in their estimation, both genuine and harassing. In the generality of cases they know themselves to be only just up to the mark of giving the necessary instruction. When too late, they are conscious that much time has been lost, that some subjects have been carelessly or superficially handled, and that the idleness or dulness of the pupil-teachers has been too leniently met. As the appointed day draws on, perhaps the master's solicitude about the result only increases, whilst his ability to make good the deficiencies he fears seems to have given way to hurry and confusion; and this the more so, where either the pupils have lost their courage, or else are indifferent and giggle with vain confidence. It is, however, now too late a stage in the business to regain lost ground; the inspector *must have his work done,* whatever personal difficulties may attend it on your part or the boys'; it may happen that matters are of a very different complexion: the master may have tried to do his best, and yet have found himself incompetent to the task, however sharp and attentive the pupils may have been: or else he may have had to do with louts and idlers, to whose humours he has weakly or designedly given way; or perhaps both parties have been trifling, negligent, and self-satisfied. Under any of these circumstances, the master may have abundant cause to fear the result of an impartial examination; and, as the day approaches, no wonder that he magnifies his difficulties, by way of escaping from the trap of his own devising with as much tail as possible. Yet, instead of this, surely there is rather cause for self-reproach and shame, where the mischief is traceable to him; he has much to answer for, in more ways than one, both towards his pupils and patrons; and if he be at all a person of hopeful character, he will probably learn such a lesson from his ill-conduct in the matter, as may either tend to a most thorough amendment, or his abandoning a post for which he is so manifestly unfit.

The great and final difficulty of the Inspector—The Examination of the Schoolmaster—is yet to come. This turning of the teacher himself into a scholar, throwing him into the Inspector's balance and testing the weight of his own acquirements, is an annual operation not at all welcome to most of those who are submitted to it, though a few are glad of the opportunity for instruction and self-knowledge which it affords. To some it presents a series of imaginary difficulties, which, however wholesome they may be as incentives to study and self-discipline, are yet felt to be unnecessarily humiliating and vexatious; whence the question will often burst forth from irritated and nervous tempers, "If my pupil-teachers can fully satisfy the inspector, what is the use of his bothering me every year with this stupid examination?" It gives one but a low idea of the attainments, ambition, or principles of such a host of teachers as are now filling the elementary schools of this country, to observe how few of them, comparatively speaking, have been induced to offer themselves as candidates for this honourable distinction, and thus to improve themselves in fitness for that important calling to which they are supposed to have now given up their best energies, and the main success of which must depend upon their efficiency and zeal.

However these things may be, the non-certificated must bear the rub of the inspector's annual examination of their acquirements, and of their general habits of thought, upon such subjects as seem more or less connected with the due performance of their duties. This is the fixed rule; and, however much it may be disliked or scolded, common sense and prudence point to proper and timely preparation. Where, during the past year, the master has shown himself worthy of his name, where he has taken due pains in the prescribed instruction of his pupil-teachers and exercised ordinary diligence of study as regards himself, there can be no real grounds to fear the result of his own examination. Difficulties he will be sure to encounter, for his path lies up-hill; but, as he gradually surmounts them, and the brightening landscape of knowledge becomes more expanded to his view, his labours will not only bring him present enjoyment in the consciousness of increased learning, but a most cheering hope of enlarged usefulness. And at the review of his own examination, though it may fall far short of what his examiner and himself could wish, yet, most probably, he will discover that he actually knows more than he had anticipated; and may find that the gentle pressure of a superior mind has not only drawn from him unexpected stores, but provoked him to redouble his exertions, and the next year to number himself with the aspirants for a certificate of merit.

Whatever may have been the kind or degree of preparation the teacher has made for this unwelcome trial of his attainments and powers, his best way to meet its foreboded difficulties is not to endeavour to appear more clever than he is; and we should be induced to offer him this candid advice:—Be humble; recognise your real position in the fact of your being examined at the same time and in the same place with your own pupils; for this, being your own voluntary choice, shows the estimate you make of your own intellectuals. Do not sham, or mystify, or equivocate, or fly high, or be very fine, whatever be the subject; do not guess at anything wherein you are conscious of thorough ignorance, lest you be caught adding some grave absurdity to a stupid error. If you were asked the probable age of the man in the moon, you would think it no shame to say you did not know; and if questioned as to which flourished first, Julius Cæsar or John Bunyan, and you cannot tell, it is better for you to admit it. Never take anything for granted about which you are grievously ill-informed; or imagine yourself to be somebody of importance because your opinions and views are asked on this or that. Think well before you speak or write; try and collect your scattered knowledge as you go along; examine your statements and exercises as deliberately as you can. Do not shock your examiner by slovenly blots, or free-and-easy handwriting, or slipshod spelling; do not disgust him with evasions, or cut-and-dried morsels prepared for the occasion, and wholly beside the mark. Do not affect that saucy independence or servile obsequiousness, so frequently the last resource of low and nervous minds. But under every circumstance, do your best, honestly, thoughtfully, meekly, and respectfully; and except you are really unworthy of your position, you will most likely wriggle through all the difficulties you dreaded, gain experience from your past lethargy, and learn from your examiner a few lessons of prudential wisdom against the coming year.

A VISIT TO THE ROYAL SCHOOL OF NOORTHEIJ.

BY A CORRESPONDENT.

Some time ago, having been invited by the principal of the famous school (at least in Holland) of Noortheij, to pay him and his institution a friendly visit, I took my place in a railway carriage at Rotterdam in order to accomplish my object. I went by an early train, thinking to spend a long and pleasant day in the company of the worthy principal and the various members of his academical institution. I must anticipate the conclusion of this narrative by stating, at this introductory part of it, the fact, that in this expectation I was partly disappointed; for, though I went by the first train and returned by the last, and though my almanac noted on that day an interval of about seventeen hours taking place between the rising and the setting of the sun, yet I have seldom known a day slip through my hands, as it were, in such an incredible short time as that individual day did.

In something less than an hour I arrived at Voorschoten, a pleasant little Dutch village, with rosy apple-faced boys and girls running just then, "some in glee, a few in tears," to the village school,—this said Voorschoten being the nearest station to Noortheij, and about half-way between the Hague and Leyden. It was a bright sunshiny morning, and the horticultural and floricultural charms, peculiar to this district of Holland, were blooming delightfully. A pleasant walk of about half an hour, varied with numerous greetings from the naturally polite peasantry, and the morning songs of "the feathered tenants of the air," brought me to my destination—Noortheij.

And where is Noortheij? Search for it in the most accurate of gazetteers, and you will not find it noted there as having "a local habitation or a name." Seek it in the map of Holland,—the most elaborate and correct,—and you will not find it there. Gazetteer compilers and geographers have passed over it; but an educator,—one of the perhaps most practical educators of the day,—discovered it, a solitary mansion embedded in trees and surrounded with verdure, and there he established an educational establishment, which, for more than twenty-five years has been considered the first institution of the kind in Holland.

Some thirty years ago Dr. De Raadt, the principal of this institution, visited England, for the purpose of gaining, if possible, some useful experience, and some practical ideas in the art of educating. He did not, however, find much to commend, though, as he admits, England has, in the matter of education, since that period made considerable advances in the right direction. Shortly after his return to Holland he published his "England and our own Country," a work in which he expresses very clearly his disapprobation of the educational systems then in vogue in England. He still seems to think that there is, in England generally, too much stress laid on the superficialities of education,—too much discipline of the head and too little of the heart; and that the duty of educating, which ought to devolve only on those well qualified to undertake it, is too frequently assumed by incompetent persons,—the unsuccessful at the counter or the desk,—*as a resource,* when pursuits more congenial and more fitting fail them.

There are few, I apprehend, who have studied the question, who do not feel themselves obliged, however reluctantly, to come to the same conclusion. The fault is with ourselves. The educator, as well as the lawyer, the clergyman, and the physician, should be obliged to give the public satisfactory guarantees of his ability and general fitness to undertake such an important office.

After an absence from Holland of a few years, Dr. De Raadt returned home, and established, on the plan on which it is still conducted, the educational institution over which he still presides. To a man whose heart and every feeling is enlisted in his profession, it must be a matter of deep though sometimes perhaps of painful interest, to look over the pages of a volume which the principal of this institution keeps as a treasure—the portrait gallery of his pupils. Herein, neatly sketched in pencil, and each bearing the signature of the pupil, he has the portrait of every youth that has been committed to his educational care. A pleasing association it must be also for him to find under his present charge the sons of those who, years ago, sat under him as their instructor and their friend; and learned from him those lessons of practical wisdom which taught them to become wise practitioners in that sphere of duty to which they were subsequently appointed in society. They are now spread far and wide, as statesmen, legislators, lawyers, ministers, and merchants; and the King of Holland has recently evinced his appreciation of the value of Dr. De Raadt's exertions in the cause of education by confiding to his care his eldest son, the present Prince of Orange, and (should God preserve him) the future king of Holland. May the mind, from thus being formed and cultivated by learning in youth to obey, become wise in manhood to govern.

Though this institution is intended for only a limited number of pupils—all of course resident—thirty being, I believe, the maximum; yet, were there ten times that number, the arrangements, though they would be on a correspondingly greater scale, could not be more complete. The school is divided into class-rooms, which are presided over by the respective masters in the establishment. In addition to the principal there are seven assistant masters, an Englishman, a Frenchman, and a German, being among them, as professors of the language and literature of their respective countries. A very practical method of teaching languages is adopted in this establishment,—which is that of the master relating to his pupils some narration likely to interest their attention, and then requiring them to write the same from memory as a composition, in the language in which they had heard it. These narrations are of a very varied character, great attention being given to the making of a judicious selection. Here one master entertains his pupils with tales of chivalrous achievements and valorous deeds, recorded in the pages of his own country's annals, or in the history of the world. Then another relates to his youthful audience the ultimate triumphs of oppressed virtue, and the fall of persecuting crime. One tells them of the sufferings, the perseverance, the patient constancy and the magnanimity of those who "being dead still speak" to us by their victories and renown; whilst another explains to them, by the most pleasing proofs and illustrations, the bounties of nature and the beneficence of nature's God. This process must be far less burdening to the mind than the task of learning by heart (or rather rote), as it is certainly a much more efficient exercise for the attention, the judgment, and the memory. In correcting these compositions (which takes place at the time they are being written), it is the master's duty to point out and explain the rules of grammar and of style, illustrated or violated, *en passant*. The other branches of school instruction are also taught by calling into exercise the judgment and attention, instead of burdening the mind with tedious and hated repetitions. "A place for everything, and everything in its place," in conjunction with "A time for everything, and everything at its time,'' are two regulations admirably brought into practice in this school. There are indeed "wheels within wheels," and every thing seems to go on with the regularity of clock-work. At dinner, the boys and masters sit at the same "long table," and engage in conversation; and, as everyone passes on to his neighbour the dishes placed on the table, there is no confusion with servants, one only assisting at the removal of the courses. Though of course there are necessarily several domestics in this establishment, the female servants are, with the individual exception of the one who serves at table, "myths'' to both masters and boys.

There is also connected with this institution a "club-room,'' which is the general study for the masters, each of whom finds here a desk for his own individual service, with book-shelves capable of holding the books of the most voluminous of students. Here the masters prepare their lessons, as well as engage in their private studies,—an excellent plan, for the cleverest of men are not always perfectly ready,—especially when teaching is more oral in its system than through the medium of books, to give their lessons efficiently, and, as a *master*, extemporarily and without preparation. Such preparation certainly gives a master confidence in his own powers, and that self-confidence is not lost upon his pupils. In their own private studies the masters assist each other; thus I found the Englishman teaching the Frenchman and the German English, and receiving from them in return instruction in their respective languages. There is also an extensive and choice collection of books in almost every European language, which form a most useful library, and which are for the sole use of the masters and pupils; but of course under necessary regulations. Here is also to be found, in a glass cabinet and in beautiful order, a very superior philosophical apparatus, used from time to time in experimentalizing before the pupils.

Dinner over, I took a ramble, accompanied by the principal, over the school-grounds, which are very extensive, woody, and pleasing. Here the boys were engaged, with the masters as their "elder brothers," in different games; the game just then—the game *par excellence*—was cricket. This thoroughly English amusement is scarcely known in Holland; but the English master of this school gave his pupils instruction in cricket as well as in English; and under his tuition they have made themselves very creditable cricketers. I am by no means a good cricketer myself, but yet I had the vanity to suppose that I could show my young friends a hit or two in the art to surprise them. I therefore requested an inning. The ball was well bowled, and not badly struck; but, as Heaven shall help me, a sleek, lady-handed youth, with unexpected agility, caught the ball, and of course I was "out," without a score. They all seemed vastly to enjoy seeing an Englishman so quietly tripped up, in his own national game, by "a Dutchman."

I must not forget the fencing-room, and the gymnastic room. The former is well supplied with accoutrements of warfare—swords, guns, halberts, gloves, and a large etcetera, with a clever master-of-arts—the arts of self defence—to teach the youths how to ward off the blow of an enemy, and give him a telling thrust. I ventured to accept a challenge, for the fun of the thing, and was soon disabled. In the gymnastic room you are at first puzzled to know what all those ropes, poles, and spokes can signify, with a saw-dust carpet beneath your feet. After studying the matter a few minutes, however, I discovered their purposes. This done, I attempted an experiment, when I discovered something else—the usefulness of a saw-dust carpet in softening one's fall. My young friends laughed heartily to see my "superfine black" so quickly changed into "Oxford mixture," whilst I—thinking, I suppose, of

Bruce's celebrated spider — resolved to make another attempt; and faith, I succeeded too.

I cannot suppose that the masters and boys put on the semblance of urbanity and kindness simply on account of a stranger being among them; but I was much gratified at seeing those two qualities really and essentially predominant in their conduct to each other. I by no means wish to infer that human weaknesses and sins have no control over the inmates of Noortheij; but I am strongly of opinion that an effectual moral preservative against them ought to be the basis of all scholastic operations. In English schools, it is too general for a master to consider himself as *sunk* to the position of a boy's fag, instead of *raising* himself in his own esteem as the former of minds and the moulder of souls. For it is in the school, said Dr. De Raadt, and by school associations, that the youth is formed into the man. What the child is, the man necessarily will be; and what individuals are, such will be the nation. Thus, as the school forms the character of the child, it forms also that of the nation. The future character of a nation, therefore, is now placed in the hands of the schoolteachers of such nation, to be moulded, as it were, at their discretion. And yet teachers are prone to consider theirs an unworthy and fagging office; and, at the best, to consider the teacher's desk only as a stepping-stone to some, in their estimation, more honourable profession.

A teacher has undoubtedly many difficulties to encounter; but those difficulties he himself increases tenfold when he fails to respect his office; and, like the idle man, taxed more by his own sloth than by the necessities of the State, he complains of evils which are insignificant in comparison with the evils he brings upon himself. Let a teacher attach due value to his office, and cease to regard himself simply as an instructor of certain specified scholastic head and hand acquirements, and let him become, in his own estimation, what he is—*ex officio* the educator of the minds of his pupils, and the moulder of their future character. This is an employment too elevated for a mere fag or a drudge, and far too elevated for those who embrace it simply as a resource. Surely the position of a teacher should be something higher than a refuge from the counter or the desk! Surely it is time that that position should be deemed worthy the ambition of aspiring and noble minds!

The shadows of evening had already fallen on Noortheij when I left the charming villa. Seldom have I spent a day so intellectually, so cheerfully pleasant. Since then, however, I have had the repeated satisfaction of visiting this institution; and I hope to have it again. What I have written in this sketch was written from my first impressions; and my subsequent visits have confirmed its general accuracy. I am neither bishop, priest, nor deacon; but notwithstanding I will conclude with a benediction:—May this institution, of which Holland may well be proud, continue to send forth men of practical wisdom to be her statesmen, her judges, and her merchants; and may such men as Dr. De Raadt —liberal-minded, earnest men—be selected to mould, cultivate, and educate the characters of her future princes and her future kings.

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INORGANIC CHEMISTRY.

LI.—GOLD.

Equivalent, 99·44. *Symbol*, Au. *Density*, 19·26.

This valuable metal is found only in the metallic or native state, being very widely diffused in small quantities in the older rocks. From these, by the action of various causes, it finds its way into the sand of rivers, and is distributed in small quantities in many wide-spread deposits of coarse gravel or shingle,—as on the eastern flanks of the Ural Mountains, and over a wide belt of country in Virginia, the Carolinas, Georgia, and Alabama. These diluvial deposits furnish nearly all the gold of commerce, by a process of washing and amalgamation with mercury. Large masses of gold sometimes occur, as one of twenty-eight pounds in North Carolina. Several large nuggets have been found in California and Australia, but particularly the latter; and in Siberia a mass was found, now in the Imperial Cabinet of St. Petersburg, weighing nearly eighty English pounds. Generally, however, it occurs only in minute grains. It is also found in veins of quartz, in compact limestone, and distributed in iron pyrites. Native gold is usually alloyed with silver.

Gold is distinguished by its splendid yellow colour, its brilliancy and freedom from oxidation; by its extreme malleability and ductility; by its high specific gravity; (19·26 to 19·5) and by its indifference to nearly all re-agents. It fuses at 2016° F., and is dissolved only by aqua regia, by nascent cyanogen, and by selenic acid. The first is the solvent commonly known, and the solution contains the perchloride of gold.

Gold forms two very unstable oxides (Au_2O and Au_2O_3), which are decomposed, even by light. Two corresponding chlorides exist. The *perchloride* is a very deliquescent salt, forming a red crystalline mass, soluble in ether, alcohol, and water. Metallic gold is deposited in elegant crystalline crusts from the ethereal solution of the chloride. Ammonia throws down from solutions of gold an olive-brown powder (fulminating gold), which, when dry, explodes with heat or by percussion.

The solution of protosulphate of iron throws down gold from its solutions in a very fine brown powder, which is green, as seen by transmitted light, when diffused in water. The protochloride of tin forms a characteristic purple precipitate in gold solutions, called the *purple of cassius*, which is used in porcelain painting, and is probably a compound of the oxides of tin and gold. Gilding of ornamental work is usually performed by gold leaf; but other metals are gilded either by applying it as an amalgam with mercury, the mercury being afterwards expelled by heat, or preferably by the new process of galvanic gilding, from a solution of the cyanide of gold and potassium. *Gold wash*, as it is called, is applied by a mixture of carbonate of soda or potash in excess with oxide of gold, in which small articles cleansed in nitric acid are boiled, and thus become perfectly covered with a very thin film of gold.

LII. PLATINUM.

Equivalent, 98·68. *Symbol*, Pl. *Density*, 19·70 to 21·23.

Platinum is a very remarkable metal, and if abundant would be extensively useful in domestic economy. It is found native in the gold-workings in South America, and in Siberia, on the eastern slope of the Urals. No ore of platinum is known, except its alloy with gold, and with iridium, osmium, and rhodium.

Platinum is a white metal, between tin and steel in colour, but harder than gold or silver; and, unless quite pure, is, when unannealed, nearly as hard as palladium. A very little rhodium or iridium renders it more gray in colour, and much harder. If pure it is very malleable, especially when hot, and can then be imperfectly welded. Its ductility and tenacity are remarkable; but its most valuable property is its infusibility, which is so great that the thinnest platinum foil may be safely exposed to the most intense heat of a wind-furnace. It is soluble only by *aqua regia*, but alloys readily with lead, iron, and other base metals, so that great care is needed in using platinum vessels not to heat them in contact with any metal or metallic oxide, with which they combine; caustic potash and phosphoric acid, in contact with carbon, will also act upon platinum at a red heat. This is a most useful metal to the chemist, and vessels of platinum are quite indispensable in the operations of analysis. Large retorts or boilers are made of it for the use of manufacturers of sulphuric acid, which sometimes hold sixty or more gallons. In Russia it has been employed in coinage, for which, by its great density and hardness, it is well suited. When recently fused by the compound blowpipe or the galvanic focus, its density is about 19·9, which is increased to 21·5 by pressure and heat.

Platinum is obtained pure by digesting crude platinum in aqua regia, and adding to the deep brown liquid a solution of chloride of ammonium; this throws down an *orange-coloured precipitate*, which is a double chloride of platinum and ammonium. This precipitate is reduced by heat to the metallic state—a porous dull-brown mass, commonly known as platinum sponge. All the platinum of commerce is treated in this way. The sponge is condensed in steel moulds by heat and pressure; and, when compact enough to bear the blows of the hammer, is heated and forged until it is perfectly tough and homogeneous.

Spongy platinum is a very remarkable substance, having, as already noticed, power to cause the combination of hydrogen and oxygen, and to effect other chemical changes without being itself altered.

Platinum black is a still more curious form of metallic platinum, and is formed by electrolyzing a weak solution of chloride of platinum, when the black powder of platinum will appear on the negative electrode. The silver plates in Smee's battery are prepared in this way. It is also prepared by adding an excess of carbonate of soda, with sugar, to a solution of chloride of platinum, and gradually heating the mixture to near 212°, stirring it meanwhile. The black powder which falls is afterwards collected and dried. This powder has the property of causing union among gaseous bodies —as, for example, the elements of water —to a greater degree than the spongy platinum.

Platinum forms two oxides and two chlorides, viz: PlO, PlO_2, and $PlCl$, $PlCl_2$. The oxides are prepared from the chlorides by precipitation with alkalies, and are very unstable. The protochoride is prepared by heating the bichloride to 450°, when chlorine is evolved, and it is left as a greenish-gray insoluble powder.

The bichloride of platinum is the usual soluble form of platinum, and is always formed when platinum is digested in aqua regia. It is prepared pure by dissolving spongy platinum in this menstruum, and cautiously expelling the acid by evaporation at a moderate temperature. It gives a rich orange solution both in alcohol and water; and forms soluble salts of much interest, with many metallic chlorides. Those with the alkaline metals are the most important. The double chloride of platinum and potassium is a very sparingly-soluble salt ($PlCl_2, PCl$), which falls as a yellow highly crystalline precipitate when chloride of platinum is added to a solution of chloride of potassium. The double chloride of sodium and platinum ($PlCl_2NaCl+6HO$) is, on the other hand, very soluble, and forms large beautiful yellowish-red crystals in a dense solution. Potash and soda are most easily separated by the different solubility of their double chlorides. The double chloride of ammonium and platinum ($PlCl_2NH_4Cl$) is the orange precipitate before named, and is the only test required to determine with perfect certainty the presence of platinum in a solution.

LIII. PALLADIUM.

Equivalent, 53·27. *Symbol*, Pd. *Density*, 11·8.

This very rare metal is usually found associated with ores of platinum. It is also found alloyed with gold and silver in Brazil. It is a greyish-white metal, rather more brilliant than platinum, ductile, malleable, and extremely infusible. It is, however, fused by a compound blowpipe. It gains a blue tarnish like steel by heating in the air, which it loses by a white heat. In hardness it is equal to fine steel, and it does not lose its elasticity and stiffness by a red heat. Its density varies from 10·5 to 11·8, and it suffers no change by exposure in the air. These qualities would render it a very valuable metal, if it could be obtained in a sufficient quantity. Nitric acid dissolves it slowly, but aqua regia more rapidly. It forms two oxides and two corresponding chlorides.

LIV. IRIDIUM.

Equivalent, 98·68. *Symbol*, Ir. *Density*, 21·8.

Iridium is also associated with the ores of platinum in the native alloy called *iridosmine*, or osmiuret of iridium, which is left in black shining scales as a residuum, after digesting platinum ores in aqua regia. Iridium, when obtained pure and fused, is susceptible of a fine polish, has a pale antimonial whiteness and the fracture of cast-iron. It is somewhat ductile, as hard as unannealed steel, and fuses under the compound blowpipe. It is the densest body known, being as high as 21·80. The native alloy is much more infusible than the pure iridium, being, in fact, one of the most infusible bodies known; it is very hard, and is used to point gold pens. Four oxides and four chlorides have been described.

Thus have we enumerated the principal elementary bodies of "INORGANIC CHEMISTRY," and their most important combinations. The general properties of "ORGANIC CHEMISTRY" (the article on which is now completed) will probably make its appearance in a future number of "ORR'S CIRCLE OF THE SCIENCES."

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THE annual round of fleeting time is past,
And dark December, with his gloomy train,
Flies from the op'ning year, with fleeting haste,
And in vacuity dissolves again.

With clouds enwrapt Aquarius opes his urn,
Diffusive drop the penetrating show'rs;
Tempests, subservient to his will, return,
And Æolus emits his raging stores.

High-swelling rivers now disdain their bounds,
And seek new paths beyond their oozy bed;
Rolling impetuous o'er the fertile grounds,
They scatter devastation as they spread.

ANON.

WINTER lingers still; he is abroad, bestriding the wind, and scattering his snow-flakes around. He laughs with savage fury—hark! do you not hear him? why, he shakes the very windows, and makes the snow-clad trees crack again.

Have you reflected upon the birth of another year, pregnant with events important to all of us? If not, do so, for the birth of a new year should not be regarded with indifference by any person, be he peer or peasant.

"Then, as ye sit about your embers,
Call not to mind the fled Decembers;
But think on those that are to appear
As daughters to the instant year."

January, which is the first month of the year, was so called by the Romans from Janus, who, according to their mythology, was the god of gates and avenues. He was sometimes represented with two faces, because, on the one side, the first day of this month, he looked towards the new year, and on the other towards the old; in his right hand he held a key, and in his left hand a rod, symbolical of his opening and ruling the year. He was also represented with four heads, and placed in the temple with four equal sides, with a door and three windows in each side, emblematical of the four seasons and twelve months over which he presided.

Our Saxon ancestors called this month *Wolfmonath*, or wolf-month, because the wolves of our ancient forests, impelled by hunger at this season, were wont to prowl about and attack them. They also called it "*Alfter-yula*," or after Christmas.

The synonymes of the month are, in Latin, *Januarius;* in French, *Janvier;* in Italian, *Janiero;* and in Spanish, *Enero*.

This month was allegorically represented as a young man dressed in white, blowing his nails under his left arm; he had a billet, thereby denoting the season of the year. The sign of Aquarius was also represented near to him, symbolical of the rain and snow which fall in abundance during the month, and of the sun entering the sign of *Aquarius*, or the water-bearer, on the 21st of the month.

The chronology of the month is given below:—

Calendar for the Month.

1. *Circumcision.* —Charles II. crowned, 1651.
2. Edmund Burke born, 1730.
3. Cicero born, B.C. 107.
4. West Indies discovered, 1492.
5. Duke of York died, 1827.
6. *Epiphany.*—Twelfth Day.
7. Allan Ramsay died, 1758.
8. *Lucian.*—Galileo died, 1642.
9. Royal Exchange burnt, 1838.
10. Penny Postage commenced, 1840.
11. Sir H. Sloane died, 1753.
12. Lavater died, 1804.
13. Earl of Eldon died, 1838.
14. Edward Halley died, 1742.
15. Dr. Aikin died, 1747.
16. Sir John Moore killed, 1809.
17. Benjamin Franklin born, 1706.
18. *Prisca.*—Houses of York and Lancaster united, 1486.
19. James Watt born, 1736.
20. *Fabian.*—John Howard died, 1790.
21. *Agnes.*—Miles Coverdale died, 1568.
22. *Vincent.*—Bacon born, 1561.
23. Duke of Kent died, 1820.
24. Fox born, 1749.
25. *Conversion of St. Paul.* Dr. Jenner died, 1823.
26. Sunday Schools established, 1784.
27. Dr. C. Hutton died, 1823.
28. Sir F. Drake born, 1596.
29. George III. died, 1820.
30. *Martyrdom of King Charles I.*, 1649.
31. Ben Jonson born, 1574.

The Red Letter Days of the month are as follow:—

1st. "*Circumcision,*" or "*New Year's Day.*"—This was kept as a festival of the Greeks, in which they celebrated the completion of the sun's annual course, and rejoiced that it had again begun its enlivening progress; and in honour of Janus by the Romans, who were in the habit of sending presents of dried figs, dates covered with leaf-gold, also honey and other sweetmeats, to their friends,—expressing a wish that they might enjoy the *sweets* of the year into which they had just entered. They also visited and congratulated each other, and offered up vows for mutual preservation. The Day of Circumcision was instituted in the Christian Church by Pope Felix III., A.D. 487, under the denomination of the *Octave of Christmas;* and introduced into the English Liturgy in 1550, in commemoration of the circumcision of Jesus Christ, according to the Jewish ritual, on the eighth day after his nativity.

The first of January having been observed by Pagan nations as a day of rejoicing, and for offering up sacrifices to the idol Janus, the primitive Christians celebrated it as a *Fast*, in order to avoid even the semblance of joining in their customs and worship. According to the Catholic legends, it was held in such high esteem by the Romans, that they would not sully it, even by martyring the Christians, at such a joyful period! It is still kept as a holiday throughout the several nations of Europe and America; the bells of most of the churches being rung at midnight to welcome the *New Year*.

6th.—"*Epiphany.*" This day was kept in remembrance of the manifestation, or showing of Christ to the wise men, who, having seen his star in the East, went in search of him and found him at Bethelem, where they worshipped and offered sacrifices.

There was a great difference of opinion respecting the *origin* of Twelfth-Day, but it appears to have been decided at last, as follows:—" That the practice of choosing King on Twelfth-Day, is similar to a custom that existed among the ancient Greeks and Romans, who, on the festival days of Saturn, about this season of the year, drew lots for kingdoms, and, like kings, exercised their temporary authority." Many curious local customs prevail respecting Twelfth-Day, which is called thus from its falling on the twelfth day after Christmas-Day; but, as they would almost fill a good-sized volume, we abstain from any mention of them.

8th.—" *St. Lucian*" was a learned Syrian, who died in the year 312, and is said to have instructed Arius in the doctrine that distinguishes the sect of Arians from others.

18th.—" *Prisca*" was a female who was beheaded in 275, by order of the Emperor Claudius, after enduring torture to make her abjure the Christian faith.

20th.—" *Fabian*" was the nineteenth Bishop of Rome, being elected to that office in the year 241; and, after being bishop thirteen years, suffered martyrdom in the Decian persecution.

21st.—" *Agnes.*" St. Agnes was a young Romish maiden, who suffered martyrdom under Diocletian, 303. A custom prevailed, in various parts of England, of young women performing certain ceremonies, in order that they might dream of their future husbands.

22nd.—" *St. Vincent* " was a Spanish martyr, who died in 304, after enduring torture by fire.

25th.—" *Conversion of St. Paul.*" This is a festival held in commemoration of the conversion of St. Paul, and is kept by the Churches of England and Rome.

30th.—" *Martyrdom of King Charles I.*" This is observed by the Church of England, to perpetuate a remembrance of the beheading of King Charles I. We believe that the sheet which received the head of the unfortunate monarch, his watch, and some other relics, are preserved at Ashburnham.

Put on your great coat; for although the weather is dry, and the sun's rays are enlivening the gardens and fields, yet the air is keen, for January is the coldest month of the year. We will take a walk into the garden, and observe the flowers and shrubs. Here is our old friend the Christmas rose (*Helleborus niger*), still in flower; the laurustinus (*Viburnum Tinus*); the rosemary (*Rosmarinus officinalis*), emblem of constancy; the bearsfoot (*Helleborus fœtidus*); the scented colt's-foot (*Tussilago fragrans*); the graceful snow-drop (*Galanthus nivalis*); the Persian cyclamen (*Cyclamen Persicum*); the ivy-leaved cyclamen (*C. hederæfolium*); the Japan Quince (*Cydonia Japonica*); the garden anemone (*Anemone hortensis*); the snow-flake (*Leucojum vernum*); the broad-leaved candy tuft (*Iberis semperflorens*); and the winter aconite (*Eranthis hyemalis*),

> " With butter-cup-like flowers that shut at night."

Among the birds we may observe the snow-bunting, or snow-fleck (*Emberiza nivalis*); the aberdevine (*Carduelis spinus*); the tufted duck (*Fuligula cristata*); the grosbeak (*Pyrrhula enucleata*); and oftentimes we may hear, as well as see, the woodlark (*Alauda arborea*); the song thrush (*Turdus musicus*); the robin (*Sylvia rubecula*); the blackbird (*Merula vulgaris*); the chaffinch (*Fringilla spiza*); and the wren (*Anorthma communis*).

The entomologist will find the following list of insects to be those that are chiefly obtained during January, viz., the peacock (*Vanessa Io*), and tortoiseshell (*V. Urticæ*; butterflies; the winter moths (*Cheimatobia biserrata*), and the early (*C. rupicapraria*); the chain (*Carabus catenulatus*); the thief (*Ptinus Fur*), and the great water beetle (*Hydrophilus piceus.*) In addition to the above there are gnats, lady-birds, &c., all affording instruction and pleasure to those who pursue the science of entomology with ardour and patience; for it requires both.

The quadrupeds of the month are the hedge-hog (*Erinaceus Europæus*); the squirrel (*Sciurus vulgaris*); and the dormouse (*Myoxus avellanarius*). In mild evenings we may sometimes observe a few bats (*vespertillo murinus*), &c., flying about in pursuit of insects.

Farewell, dear friends, may you all experience many, many happy new years; and never have cause to look back with regret upon the years that have past. Employ your time profitably, and always let Nature be your master and model.

THE TEACHER, AND HIS REWARD.

BY D. P. PAGE.

It is proverbial that the *pecuniary* compensation of the teacher is, in most places, far below the proper standard. It is very much to be regretted, that an employment, so important in all its bearings, should be so poorly rewarded. In New England there are many young women who, having spent some time in teaching, have left that occupation to go into the large manufacturing establishments as labourers, simply because they could receive a higher compensation. I have known several instances in which young ladies, in humble circumstances, have left teaching to become domestics, thus performing the most ordinary manual labour, because they could receive better pay; that is, the farmers and mechanics of the district could afford to pay more liberally for washing and ironing—for making butter and cheese—for sweeping floors and cleaning paint—than they could for educating the immortal minds of their children!

Nor is this confined to the female sex. Young mechanics and farmers, as well as those employed in manufacturing, frequently receive higher wages than the common school teacher in the same district. Many a young man, who has only genius enough to drive the pegs of a shoe in a regular row, and skill enough to black the surface of the article when it is completed—having spent but a few weeks in learning his trade—receives more money for his work than he who, after having spent months, or even years, in gaining the requisite qualifications, labours to polish that nobler material—the human soul.

The injustice of this becomes more apparent, when we bear in mind that public opinion demands, and justly too, that the teacher should be not only gentlemanly in his manners, but better clad than the mere labourer—thus throwing upon him a greater burden, without affording him the means of sustaining it. The female teacher of a district school, in order to be respectable, must be much more expensively dressed than the domestic in the family where she boards, and is thus compelled to consume most of her receipts upon her wardrobe—while the domestic is able to place surplus money at interest in the Savings Bank. This injustice has so often been laid before the people, and yet has been so long continued, that many have given up in despair, and abandoned an employment that has yielded so little, choosing rather to engage in that lower service which is so much better paid.

This sufficiently explains why so many unqualified teachers have been found in our common schools. Men of talents and ability being tempted to other employments, have left the field unoccupied; and those men who have failed to gain a comfortable living by their hands, have been allowed to try the experiment of supporting life *by their wits*—that is, by becoming teachers!

Such has been the case for a long time past; and, though in many quarters the people are beginning to open their eyes to their true interest, and are gradually and commendably coming up to their duty, yet, for some time to come, the pecuniary compensation will not constitute the chief reward of the teacher. If he will go cheerfully to his work, and find his daily enjoyment in his daily toil, he must have a higher object—some more elevating, inspiring motive—than mere money-getting. The chief encouragements of the faithful teacher lie in another direction.

It is but just, however, that the teacher should be invited to look at the brighter side of the picture; so that, when he is ready to sink under the responsibilities of his position, or yield to the obstacles that oppose his progress, he may have something to animate his soul, and to nerve him anew for the noble conflict.

The teacher's employment affords the means of intellectual growth. If a man teaches as he should teach he must of necessity improve himself. Teaching, understandingly pursued, gives accuracy. I know it is possible for a man to be a mere schoolmaster—a *pedagogue*,—without any self-improvement. But I am speaking of the faithful, devoted teacher,—the man who studies, reflects, invents. Such a man learns more than his pupils. Every time he takes a class through any branch of study, he does it more skilfully, more thoroughly, than before. He brings some fresh illustration of it, presents some new view of it, and hence takes a lively interest in it himself, and awakens a new zeal among his pupils. Measuring himself by his new success, he feels a *consciousness* of growth,—of progress. This consciousness is a precious reward.

The teacher's employment affords the means of moral growth. Brought constantly in contact with those who need a careful guidance, he feels impelled to earnest effort, in order to obtain the mastery over himself, as the best means of gaining complete influence over others. Studying the weak points in their character, he is constantly reminded of those in his own; and self-knowledge is the first step toward self-improvement. Beginning in the feebleness of inexperience, he bolsters up his authority at first by a frequent resort to force; but, as he goes on, he finds himself gradually gaining such ascendancy over the vicious as to control them quite as effectually by milder means. At first easily excited to anger or impatience, he frequently indulges in severe language when it was unnecessary,—but by careful discipline he has learned to "set a watch before his mouth and to keep the door of his lips." Encouraged by one victory over himself, he is prepared for another. Having learned by self-discipline to control his outward acts, he next attempts the mastery of his thoughts. He soon finds that his moral power over others is very much increased. Somehow—though perhaps he cannot yet tell the reason why—he finds he can secure obedience with half the effort formerly required,—he gains the love of his pupils more readily,—and, with the exception now and then of an extreme case, he finds that he excites a deeper interest than ever before in the whole round of duty among the scholars. Why is this? he asks,—and the consciousness of increased *moral power* rising up within him, is a source of the highest satisfaction. Pecuniary emolument sinks into nothing, considered as a reward, when compared with a conscious victory over himself.

A consciousness of improvement in the art of teaching is another reward. Such improvement will follow, as a matter of course, from his self-improvement in the particulars just named. As his own mind expands, he feels a new impulse to exert himself to interest others in the subjects he teaches. He soon comes to look upon the work of instruction, not as a mere mechanical business, to be done in a formal way, but as a noble art, based upon certain great principles that are capable of being understood and applied. He employs all his ingenuity to discover the natural order of presenting truth to the mind,—to ascertain the precise degree of aid the learner needs, and the point where the teacher should stop. He studies carefully the proper motives to be presented as incentives to exertion. Interested in his labour as a great work, looking upon his influence as telling upon all future time, he devotes himself daily with new zeal, and is rewarded with the consciousness of new success.

The teacher is permitted also to witness the constant growth of mind among his pupils. I say constant, because the teacher is not obliged to labour without seeing immediate results. The minister of religion may sometimes sow the seed of the good word, while the fruit does not appear for a long season. Sometimes a spiritual apathy prevails; so that the most faithful warnings and the most earnest appeals seem to fall powerless upon the conscience; and he is led almost to despair of ever being able to break the deathlike slumber. It is not thus with the teacher. His labour tells immediately upon the young mind. Even while he is yet speaking he is gratified with observing the soul's expansion, as it grasps and assimilates some new idea which he presents. From day to day, as he meets his classes, he sees how they go on from strength to strength,—at first, indeed, with the halting, tottering step of the feeble babe, but soon with the firm and confident tread of the vigorous youth.

A teacher who is for several years employed in his vocation, is often astonished at the rapidity with which the young, who came to him as mere children, grow into men and women, and take their places on the stage of life as prominent actors. Some of them distinguish themselves in the arts; some become noted for their attainments in science; some receive the honours of office, and become leaders in civil affairs; some gain eminence as professional men; and very likely a large portion of them are engaged in the various departments of honourable industry. Wherever they are, and whatever they are, they are now exerting a powerful influence in the community. They have grown up under his eye, and have been essentially shaped by his plastic hand. He looks upon them almost with the interest and pride of a father. He counts them as his jewels; and when he hears of their success, their usefulness, and their honours, his heart leaps within him, as he thinks, "they were my pupils!"

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HISTORY OF HARRISBURG, AND THE INDIANS OF PENNSYLVANIA.

Harrisburg is the capital of Pennsylvania in the United States, with the early foundation of which many interesting events are connected; and, as few subjects can be more instructive, in an educational point of view, than the origin and history of towns and cities—which, from a state of mere barbarism, have suddenly emerged into civilized existence—we feel great pleasure in presenting the following details, communicated by a Transatlantic correspondent.

John Harris, the founder of **Harrisburg**, from whom the name was derived, was originally a trader among two or three savage tribes, whose head-quarters extended along the west branch of the Susquehanna, in Pennsylvania, about the middle of the last century.

One of these tribes, believed to be the Muncies, an off-shoot of the Delawares, had built their wigwams, and settled their families, at the junction of the west and north branches of the Susquehanna, on the site of the present village of Northumberland. The towns of the others receded farther into the wilds along the west branch. A chain of posts was established during the provincial government of Pennsylvania, about 1756, by Governor Forbes, extending from Philadelphia to Fort Pitt—now Pittsburg. One of these was where Harris resided, who occupied a trading house, and had rendered himself acceptable to the Indians, who found it a great convenience to trade their peltries for powder, lead, and such other things as they needed, in their own neighbourhood. Here he had brought a plough, the first ever seen on the banks of the Susquehanna, with other implements of husbandry, and made a little clearing sufficient for a kitchen-garden; and here was born John Harris, the founder of Harrisburg, believed to be the only individual ever existing that laid out a town at his birth-place; and who, as the first child of white parents, received, from that circumstance, a grant of four hundred acres of land, offered as a premium by the proprietors, for the settlement west of the then frontier parts of Eastern Pennsylvania—Berks and Lancaster counties. After Braddock's defeat, one of the British officers, on his way to Philadelphia, called at Harris's station, for the purpose of staying all night. Through the neglect of the person whose duty it was to attend to closing the port-holes at sundown, they had been on that day left open. The officer was engaged in conversation with Mrs. Harris, with his back to the port-holes, and she facing them. In this position, and looking over his shoulder, she heard the click and saw the flash of a rifle. Without any exclamation of surprise, or saying anything to interrupt his discourse, she leaned to one side where the candle stood, and blew it out. The next day the officer fell in with an old Indian chief and his attendant, who acknowledged to him that he had aimed at his life, but the weather being drizzling, his powder had got wet and the piece hung fire; and he was unwilling to repeat his fire, after the candle was extinguished, for fear of injuring Mrs. Harris.

When the Pennsylvanians had extended themselves west of the Donegal settlement, in Lancaster county, and had formed a settlement on Paxton creek, the Indians began to entertain great apprehensions of being finally expelled the country, and concerted measures, with their usual secrecy, for the extirpation of the whites. Having ascertained that they collected once a week for religious worship, they made their arrangements to attack Paxton meeting-house, and cut off all the inhabitants at a single blow. They rendezvoused in considerable numbers at a spot west of the Blue Mountains, and poured in on the settlement through *Monada Gap*, about fourteen miles from the Susquehanna, with such celerity and secrecy as to station themselves in the thicket around the meeting-house, without the least suspicion having been formed by the settlers of any sinister designs. They had, however, missed one day in their reckoning, and taken Saturday, in place of the Sabbath, for their ambuscade. Thus, fortunately, they were completely foiled in their contemplated attack.

A spirit of hostility, however, continued to pervade the minds of the Indians. Harris, who was held in some degree of respect by some of the natives, in one of his adventures met an old Indian, whom he recognised as having once been indebted to him for his life. The savage, without halting or turning his head, or even glancing at Harris, for he was aware, on account of his friendly feeling to that individual, that he was narrowly watched, passed him, and in a hurried manner, said, "John Harris, don't you cross the river!" After starting for home, Harris mentioned to his company this warning, as he understood it to be, of a meditated ambuscade on the other side, and suggested the propriety of going down on the west side of the Susquehanna.

The party generally judged it rather a decoy to induce them to rush into the danger, which they supposed was actually on that side. Harris then explained to his friends the relation in which he stood to the Indian, avowing his conviction that he was sincere, and appealing to the party whether they were not convinced that they owed it to their thorough preparation for battle that they had been permitted to leave the Indian camp, instead of following the friendly advice. The party, however, were obstinate; and rather than separate from them, Harris, against his better judgment, accompanied them on their route. Scarcely had the first boat in which they crossed touched the opposite shore, when a destructive fire opened on them from the bushes which lined the bank. Harris was the only one of the party that escaped to tell the tale; the residue being either shot down in the boats or overtaken at a disadvantage. He swam the river across three times to baffle the pursuit made in his case.

Harris generally rode a horse which was well known to the Indians. On another occasion, while the whites and Indians were on unfriendly terms, he had been with a party of the settlers hunting on the west side of the river, who had imprudently, by some circumstance, become separated from their rifles. The Indians attacked the party, after detaching a few warriors to intercept their retreat by a narrow defile. The bank of the Susquehanna is very precipitous in that region, and this afforded the only opening to the ford opposite the settlement. Harris was as usual mounted, and making his way down to the pass, when he found himself confronted by an old chief, well known to him as Indian John, who stood in the pathway with his rifle raised to shoot. He was compelled to risk the shot. Leaping instantly to the ground, he ungirthed the saddle, held it by the girths twisted over his arm, and vaulting on his horse's back, stooped forwards, raised the saddle, and holding it in front, so as to form a shield, he rushed at his enemy at the top of his speed. The Indian sprang to one side, disconcerted. As soon as Harris passed the foe, he swung the saddle over his head, so as to form a protection for his rear, and pursued his way to the river. The Indian fired; his ball taking effect on the saddle, the rider and horse escaping unharmed. One of the party, whose horse had been shot down (a little Dutch doctor), had reached the edge of the river; and when Harris overtook him there, he begged with such earnestness that he would take him on behind him, that Harris could not resist his entreaties, although fearful of encumbering his progress through the water with the added weight. He was accordingly taken on behind; but they had hardly got fifty yards into the stream when a ball struck the doctor, killing him instantly. The Indians were at the horse's heels, and the humanity of Harris, in place of endangering his escape, had proved the means of saving his life.

A short time before the massacre at Paoli, Harris's house had been made a depository of powder, to protect it from falling into the enemy's hands, in case they should penetrate into the Lancaster settlements. It was stored in the garret of the building, one barrel having been unheaded, and left open for retail purposes. His negro, Hercules, had been sent to get some grain from the loft, and, having occasion to set the candle down, stuck it into the open powder, which he took to be flax-seed. Fearing an accident, Mrs. Harris followed; and slowly withdrawing the candle, pointed out to him the danger he had escaped. Such was his alarm at the suggestion, that he ran to the stairs, and made but one step to their foot.

During the revolutionary struggle, when

public credit was at the lowest ebb, and Congress had appealed to the public spirit of the American people for aid in contributions of money, provisions and clothing, Mrs. Harris left Harrisburg at daylight with one hundred guineas, all the money her husband had on hand at the time; and rode in that evening to Philadelphia, being one hundred miles in one day, and paid the money to the committee appointed by Congress to receive it. Such was the patriotism of that period.

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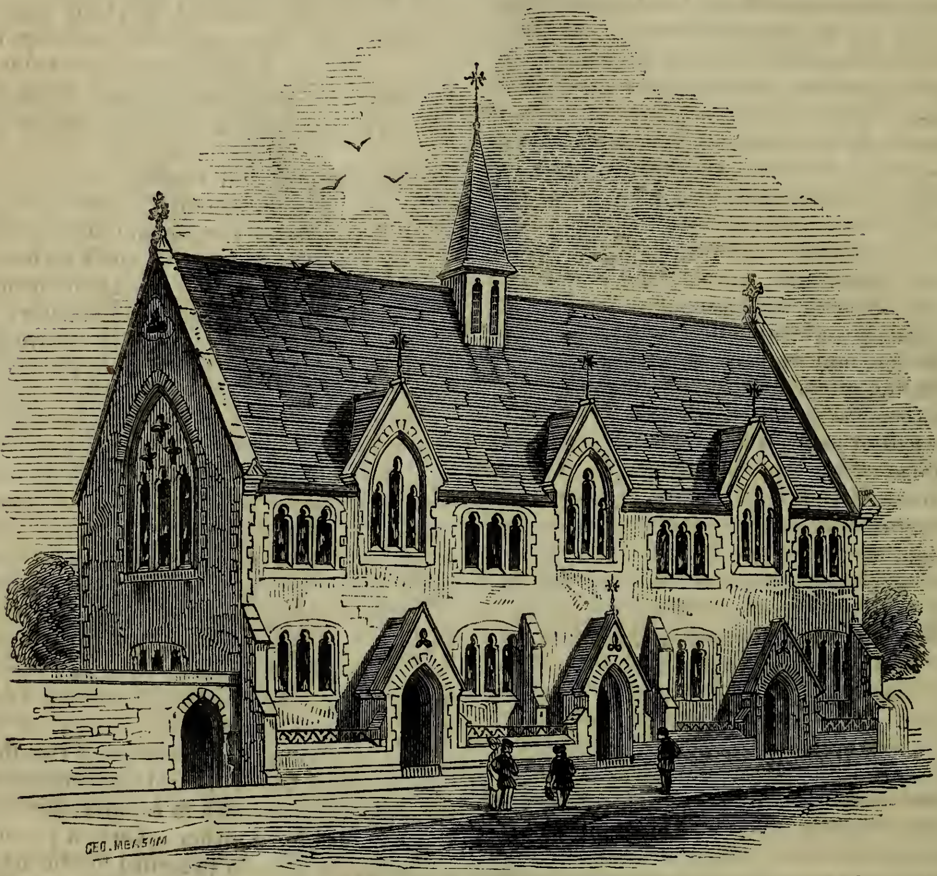

NEW NATIONAL SCHOOL AT LIVERPOOL.

A National School, of which the above is a representation, has been lately erected at Liverpool, in that important and populous part of the town which is situated in the neighbourhood of the railway station. It is in the very heart of Edgehill, which forms the great traffic of communication with the docks and great commercial thoroughfares. The general architecture is well suited for the objects in view, viz., stability, light, ventilation, and roominess; and the general effect is pleasing. The louvre, which springs from the bold gable roof, is intended not only for ornament, but for the general purposes of ventilation. The entire building consists of three principal rooms—the one for boys, the other for girls, and the third for infants. The boys' school, which forms the upper story, and is well lighted, is about 87 feet long by 30 feet broad. It is gabled; and, at the springing of the roof from the walls, is 15 feet high, though at the centre it is 44 feet. The girls' school, which is situated below, is 15 feet high; and in length and breadth it is 40 feet by 30. The infant school is of about the same dimensions as the girls'. Connected with the building there are very commodious playgrounds. The general construction and adaptation of the school was taken from the design of Mr. Lloyd, the architect, of Liverpool.

CHURCH OF ENGLAND SCHOOLMASTERS' ASSOCIATION.

The consolidation and successful career of this important Association—so essential to the well-being of a large and educated class—cannot fail to be deeply interesting to all who are engaged, directly or indirectly, in the great cause of National Education. Already have the rules and regulations of the Association been printed, and extensively circulated. Its distinct title is,—"The General Associated Body of Church Schoolmasters in England and Wales;" and its specific objects are—"The bringing together, in closer bonds of sympathy and co-operation, the whole body of Church Schoolmasters."

Any Church Schoolmaster, in England or Wales, may become a member by contributing, on or before the Annual Meeting, *One Shilling*, as a subscription for the succeeding year; and each and every such member shall have a vote in the election of General and District Officers—have his name inserted in a list of members for that year—and receive a report, containing that list, as soon after the Annual Meeting as it can conveniently be printed.

The general Association is divided into various districts, as follows:—1. London, comprising the counties of Middlesex, Surrey, Kent, Sussex, Hants, and Berks. 2. Lancashire, comprising also Chester, Salop, and Stafford. 3. Yorkshire. 4. Birmingham, comprising the counties of Warwick, Worcester, Hereford, Monmouth, Gloucester, and Oxford. 5. Northampton, with the counties of Leicester, Northampton, Huntingdon, Bedford, and Bucks. 6. South-Western, comprising the counties of Wilts, Somerset, Dorset, Devon, and Cornwall. 7. Cambridge, with the counties of Norfolk, Suffolk, Essex, Hertford, and Cambridge. 8. Durham, with the counties of Northumberland, Cumberland, Westmoreland, and Durham. 9. Nottingham, comprising the counties of Derby, Nottingham, and Lincoln. 10. North Wales. 11. South Wales.

On the 19th of November, a meeting of the United Association was held at the St. Thomas Charterhouse Schools, London, for the purpose of making the necessary arrangements for convening a general meeting of schoolmasters at Christmas. It was not thought necessary to invite the attendance of any very large number of schoolmasters on the occasion; but care was taken that the schoolmasters of the various Protestant denominations should be represented at the meeting.

In pursuance of the resolutions then passed, the first Annual Meeting was to be held in Shaftesbury Hall, Aldersgate-street, London, on Thursday and Friday, the 29th and 30th of December 1853, for the purpose of adopting such regulations as might be conducive to the interests of the Association, and reading papers, lessons, &c. It only remains for the various Local Associations throughout the country to nominate one or more of their members to attend such meeting on their behalf, and for as many other schoolmasters as can conveniently do so, to make arrangements to attend in their individual capacity.

LESSONS IN FRENCH.

PRONOUNS.

Of the Demonstrative Pronouns This That, These, *and* Those, *and Personal Pronouns* He, She, It *and* They, *used with the Verb* To be, *when this Verb is followed, either by a Noun preceded by* The *or A, a Personal Pronoun, or a Verb.*—Whenever any of the demonstrative pronouns, or any of the personal nominative pronouns of the third person singular or plural, is used as the nominative of the verb *to be*, and this verb has for its object either a verb, a personal pronoun, or a noun preceded by the article *the*, or any other word performing the same function, or by the adjective *a*, those pronouns are generally expressed in French by the denominative pronoun *ce;* and the verb *to be* is also generally used in the singular, unless it is immediately followed by a plural noun, or a personal pronoun of the third person plural, standing as the nominative of the next verb, or simply as the direct attribute of the verb *to be;* as in, Do you see this poor cottage? this, or that, is all his fortune, Voyez-vous cette pauvre cabane? *c'est* toute *sa fortune?* A little house and a few pieces of furniture, these are all his fortune, Une petite maison et quelques meubles *c'est* là toute *sa fortune.* Who is that gentleman? He is my father's lawyer, Qui est ce monsieur? *C'est l'avocat* de mon père. Do you see that officer? He is a captain in my regiment, Voyez-vous cet officier? *C'est un capitaine* de mon régiment. Do you know this lady? She is my brother-in-law's sister, Connaissez-vous cette dame? *C'est la sœur* de mon beau-frère. Look at those pretty children; they are my father's pupils, Regardez ces jolis enfants; *ce sont les élèves* de mon père.

Of the use of the Pronoun Ce, *with the Verb* To Be, *in Interrogative Sentences.*—Whenever the sentence in which the pronoun *ce* is required as a nominative for the verb *to be,* is either affirmative or negative, that pronoun may be employed in all the tenses of that verb; but if the sentence were interrogative, euphony only permits of its being used in the following tenses and persons—*est-ce, sont-ce* (third person singular and plural of the present of the indicative), *était-ce* (third person singular of the imperfect), *fut ce* (third person singular of the preterit definite), *sera-ce* (third person singular of the future absolute), *serait-ce* and *seraient-ce* (third persons singular and plural of the conditional present), as in,—Is it your father who came this morning? *Est-ce* votre père qui est venu ce matin? Are these the horses which you brought from England? *Sont-ce* là les chevaux que vous avez amenés d'Angleterre? Was it your brother who was speaking when I came in? *Etait-ce* votre frère qui parlait quand je suis entré? Was it your colonel who presented the petition to Napoleon? *Fut-ce* votre colonel qui présenta la pétition à Napoléon? Will it be he who will be appointed secretary of the navy? *Sera-ce* lui qui sera nommé ministre de la marine? Were he my best friend, I should condemn him, *Serait-ce* mon meilleur ami, je le condamnerais. Were they my own children I would not spare them, *Seraient-ce* mes propres enfants, je ne les épargnerais pas.

Of the Expression si ce n'est, if it is not, *followed by a plural noun.*—The expression *si ce n'est,* when used in the sense of *except,* is never used in the plural, even before a plural noun, because it performs the functions of a preposition, which is always undeclinable; as in, Who will help me except my friends? Qui m'aidera *si ce n'est* mes *amis?* Whom shall we love if not the ladies? Qui aimerons nous *si ce n'est* les *femmes?*

Of the Nominative Pronouns He, She, It, *and* They, *used with the Verb* To Be, *when the Verb is either followed by an* Adjective, *a Noun used as an Adjective* (*that is to say, not preceded by* The *or* A) *or an Adverb of Qualification.*—Whenever the verb *to be,* having for its nominative any of the personal pronouns *he, she, it,* or *they,* instead of being followed either by a pronoun, a noun preceded by *the* or *a*, or a verb, is followed either by an adjective, a noun used as an adjective (that is to say, not preceded by *the* or *a*), or an adverb of qualification, these nominative pronouns, instead of being expressed in French by *ce,* are rendered by one of the personal nominative pronouns, *il, elle, ils,* or *elles,* according to the nature of the sentence; as in, It is worthy of a great nation to build hospitals for their wounded soldiers, *Il est digne* d'une grande nation de construire des hôpitaux pour ses guerriers invalides. Do not depend upon him; he is not a man of his word, Ne comptez pas sur lui; *il n'est* pas *homme* de parole.

Of the Compound English Pronoun What, *used for* That Which, *when used at the beginning of a sentence, the second Proposition of which begins with the Verb* To Be.—Whenever a sentence begins in French by the pronoun *ce,* followed by a relative pronoun, both being most generally expressed in English by the compound pronoun *what,* if the second proposition begins with the verb *to be,* the demonstrative pronoun *ce* should be repeated or omitted before that verb, according to the following rules:—(1.) When the verb *to be* is followed by an adjective, the pronoun *ce* is not repeated before that verb; as in, What you have just told me is horrible, *Ce que* vous venez de me dire *est horrible.* (2.) When the verb *to be* is followed by a verb, or a personal pronoun, the pronoun *ce* is invariably repeated before that verb; as in, What I wish the most is to go and see you, *Ce que* je désire le plus, *c'est* d'*aller* vous voir. What attaches me to life is yourself, *Ce qui* m'attache à la vie *c'est vous.*

Thus have we treated copiously of the French Pronouns, because they constitute one of the greatest difficulties of the language.

EDUCATIONAL AND SCHOLASTIC MATTERS.

NATIONAL AND DENOMINATIONAL EDUCATION.

WHETHER primary education should be imparted in connection with, or independent of, religious doctrines, still constitutes a great bone of contention, and, we regret to say, tends to impede, in many respects, the onward progress of moral and intellectual instruction. As a matter of theory, however, it appears sufficiently clear that, if education is to be imparted on a scale worthy of its importance, and on sound and reliable principles, neither neglecting that knowledge essential to man as an immortal and responsible being, nor undervaluing that instruction which is required for so many purposes of ordinary life and economical progress, the religious and secular instruction of the people ought to be intrusted to separate hands. It is no answer to say that religion is the most important part of education, and that mere intellectual improvement without it is of small account, or even hurtful. No one dreams of separating religion from education; the only question is, whether certain homely and necessary arts, such as reading and writing, may not be taught without teaching religion at the same time and the same place, when it is found that, by insisting upon connecting their acquisition with the teaching of religion, we materially diminish the number of those who acquire them. The fallacy seems to lie in the use of the word "education." Because religion is essential to education, and reading and writing are the education of the poor, it is inferred that the teaching of religion should be an inseparable concomitant to the teaching of reading and writing. Now, reading and writing are not education, but merely certain arts and appliances by which education may be obtained; and there seems no more reason for connecting hem with the teaching of religion than for stipulating that no one shall teach the business of a bricklayer or a carpenter unless he accompany his lessons in the art with theological instruction.

DRAWING A PART OF NATIONAL EDUCATION.

An important circular has lately been issued by the Board of Trade (Department of Science), to masters of schools throughout the kingdom. Its leading object is to collect evidence as to the best modes now practised of affording instruction in drawing. At the same time the circular gives the following useful hints:—"Experience has proved that before a scholar is set to draw from a model, it is necessary he should learn to use the pencil, and acquire the power of making lines correctly, and that to do this he must be exercised in copying flat examples. Individual teaching to great numbers is impossible in the present state of matters, and it is not necessary for success. At Chester one master has upwards of 1000 scholars under his charge, who are taught in classes of about twenty or thirty each. He draws an object on a black board, in the presence of the class, explains the mode of holding the pencil, &c., the point for beginning the object, shows the principal lines of construction, and catechises the children about the form of the object and its meaning. Leaving some parts unfinished, he asks them if he has drawn it complete? If not, where it is incomplete? How it is to be made complete? &c.; and thus excites considerable interest in the work among the children. He summons the classes to show their work on their slates. He then selects examples of the best and worst performances, and criticises them in the presence of the children. It is desirable that the masters of schools should say if they have adopted this or any other plan, and how they have found it to succeed."

COLLEGE OF PRECEPTORS.

The plan now in contemplation, of holding periodical examinations in the College Rooms for pupils of schools who may be desirous of competing for certificates, is one which is likely to prove useful both to teachers and pupils. A similar plan—similar at least in principle—has been found to work well in many parts of the Continent, where it is customary to hold public examinations once a year in some central town, open to all schools which choose to attend. The examinations are presided over by the mayor and public officers of the town, whose presence gives a certain *eclat* to the proceedings, and confers an additional value, in the eyes of the pupils and their friends, on such distinctions as are gained by the successful candidates. There is something of the kind at King's College every year—an aggregate meeting of all the schools in union, some time in August, when the prizes are awarded in the presence of the Council and the visitors and other dignitaries, lay and episcopal, connected with the institution.

At a recent meeting of the Council of the College, the Rev. Dr. Jacob, President, in the chair, it was unanimously resolved—"That an examination of Pupils of Schools in connexion with the College, be held at the College rooms four times in every year; viz., at or before Easter, Midsummer, Michaelmas, and Christmas; and that these examinations be open to the pupils of any such schools, at an inclusive charge of 5s. each candidate."

CHURCH SCHOOLMASTERS' ASSOCIATION OF LIVERPOOL.

The annual report of this association for 1852-3, has been lately published, from which we learn that the society has been eminently successful during its incipient career. The report states that—During the past year, a memorial has been forwarded by this Association to the Committee of Council on Education, praying that definite Text-books might be named on the subjects required for certificate examinations, and that this was now partially done, but not to the extent desirable.

The report also mentions the success of the Birmingham Conference of Church Schoolmasters from various parts of the country, which was organized by the Liverpool Association and the Manchester Church Teachers' Institute. The resolutions passed at the Birmingham meeting have been highly approved by the profession; and the union of Church Schoolmasters in England and Wales, which resulted from that meeting, is progressing favourably.

PRIMARY EDUCATION AND THE WORKING CLASSES.

At the late opening of the Bury Athenæum, the Bishop of Manchester delivered an eloquent address on the general advantages of Primary and National Education; and, among other things, he adverted to the present lamentable contests carrying on in the manufacturing districts between the employers and their work-people, which his Lordship attributed to the present defects of our national system of education. "I cannot but conceive," he observed, "that were education—primary education in the first place, and secondary education in the next—more widely and more extensively developed, we should not see so painful a proof of the severance of interests, as I fear at present I must lament—we should not see the operatives of this large town, meaning—and I say it to those who may feel at this moment an interest in their absence—I believe, most excellently well, yet misled and deluded by not having had an opportunity of adequately reasoning on their own position, and not having had an adequate opportunity of understanding what are their real interests. The interest of the master and the labourer, and of the employer and the employed, can never be really dissevered. There may arise fluctuations in trade; there may arise angry feelings for a short time; but anything that tends to put the working men and their masters at issue with each other can only be the result of something not altogether creditable to both. It cannot be creditable to the working man, because he has not, perhaps through want of training and instruction, been able to understand the obligations imposed upon him, and the privileges he enjoys—the privilege of turning, under God, the primeval curse of labour into a blessing. It cannot be creditable altogether to the employer, because, however much he may have done, he has not provided those means of instruction which might have made the labourer sensible of his real interests."

TRAINING SCHOOLS.

The principles and practice of Training Schools appear to be working their way amongst our Transatlantic colonists. One of these institutions, in connexion with the Colonial Church and School Society, was lately opened at Halifax, in Nova Scotia; when the Rev. George Hill explained, to the numerous patrons assembled on the occasion, that the school would consist of two distinct branches—a Juvenile School, for the reception of pupils of both sexes, from the age of seven years and upwards; and an Adult School, for the purpose of educating and training teachers for the common schools of the province. The juvenile department was to be organized and conducted as a model and practising school, into which, from time to time, the students in training would be introduced, for the purpose of giving lessons under the eye of the master, and of acquiring a knowledge of the art of teaching, and conducting a school upon the most improved systems now prevalent in Europe. It will be essentially a mathematical and scientific education imparted in this school, not only calculated to expand and strengthen the intellect, but to fit the people to carry on their everyday avocations with greater ease and success. Mr. Marriott, the gentleman sent out by the society to conduct the school, said that he had come out from England to engage in this important work, determined to do everything in his power for the success of the undertaking.

CONGREGATIONAL BOARD OF EDUCATION.

Homerton College, near Hackney, has been recently transferred, by purchase, to the above influential body. In the transfer-deed, the object of the society is thus defined:—"To promote popular education partaking of a religious character, and under no circumstances accepting pecuniary aid from Government for that purpose." The nett cost of the property, as paid to the Homerton College Society, was £4700, and about £300 for fittings and furniture. The following gentlemen were appointed as the first board of trustees, viz. —Titus Salt, of Bradford; Edward Baines, of Leeds; Ebenezer Pye Smith; Joshua Wilson; Thomas Spalding; D. W. Wire, Alderman and Sheriff; John Morley; Samuel Morley; W. D. Alexander, Charles Robertson, Esqrs.; Mr. Barnes, of Bolton; and Mr. Wills, of Liverpool.

END OF VOLUME VI.

BRITISH PLANTS.

The series of articles bearing the title "British Plants" will contain the following subjects, treated in as comprehensive and popular a style as is compatible with usefulness and scientific accuracy.

First.—An introduction to the science of Botany in general, not restricted to British plants, but applicable to the entire subject. The introduction will be subdivided into the following divisions. 1st.—Organography, or Structural Botany, which will comprise a brief and succinct account of both the simple and compound, or internal and external organs of plants, illustrated with diagrams. 2nd.—The physiology of plants, or the constituent parts of plants viewed as living organisms, each contributing either to the existence, the increase, or reproduction of the plant. 3rd.—Morphology, or the position, shape, and size of organs.

Second.—On the distribution of the British plants. This section, as its title implies, is confined solely to our native plants. It will comprehend—1st, The range of the British plants; that is, the area which they occupy, or the extent of country where they are found. 2nd.—The altitudes to which they reach, and the temperatures which they severally require to reach maturity. 3rd.—The special distribution of British plants as aquatic plants, woodland plants, meadow and upland pasture-plants, &c. &c.

Third.—On the classification of plants, applicable of course to all plants both British and exotic. This portion will embrace, together with systematic Botany or Taxonomy, an exact account of the import and right application of the terms species, genus, order, class, &c.

Fourth.—A description of the orders, genera, and species of the British plants. This portion will contain—1st, A clear, concise, and adequate description of the orders, illustrated with a diagram, representing certain generally well-known British plants, accompanied with illustrations of the parts most distinctive or characteristic of the order. Under the orders will be given ample descriptions of all the genera and species of plants growing spontaneously in Great Britain, Ireland, and the Channel Isles.

Fifth.—A glossarial index to the whole subject, and an explanation of all the technicalities and unusual expressions contained in the work, with references to the paragraphs or sections where they occur.

This work, or series of papers, will embrace everything necessary for the student of the British plants, with the exact periods or seasons when they will be found, and the localities where they grow. The best methods of collecting them as specimens for the herbarium, to serve for identification in future years, will be particularly specified.

To the tyros or beginners in this science a few suggestions and cautions are deferentially offered.

1st.—To get as clear a notion as possible of the difference between inorganized and organized objects, as detailed in Taxonomy; also to learn the distinguishing characteristics of plants and animals. 2nd. —To beware of the deceptive and apparent but not real analogies between the constitution of objects forming the animal and the vegetable kingdoms; for example, the terms respiration and circulation are employed both in animal and vegetable physiology, but the functions themselves, as well as the organs whereby they are performed, differ much in the two kingdoms. In fact, the organization of plants and of animals is similar in nothing but in its results. The same objects—viz., the growth, preservation, and reproduction of both animals and plants are accomplished by means totally unlike,—as dissimilar as are the places which the individuals of these two great systems have to fill in the general economy of nature or providence. 3rd.—To observe and record facts; for example, the periods when certain plants are in flower, and certain trees are in leaf, or are leafing; the localities where certain plants are found, the soils where they thrive, the height to which they ascend, the numbers observed (their comparative rarity, scarcity, or abundance), the varieties of growth, colour of flowers, &c. All these particulars give not merely an additional interest to the study, but afford the means of comparing the vegetation of differently soiled and remote tracts, of ascertaining the exact effect of temperature on the vegetable kingdom, and, in fine, of extending the knowledge of geographical and economical Botany. 4th.—To collect specimens in all stages of the plant's growth; and, in order to have perfect specimens, the plant should be collected before the root-leaves decay or wither. A specimen should also exhibit both flowers and fruit; and if both cannot be gathered and secured on one specimen, two should be gathered. Beginners would do well to collect every plant which they do not know, and to study it in a fresh state. Some pass by and utterly neglect species which form large groups of plants, with the observation that it is only a *Grass*—a species of *Hemlock*—a sort of *Daisy*, or a *Butter-cup*, or a *Fern*. All the apparatus necessary for distinguishing of closely connected and similar-looking plants is now easily procurable. A specimen-box or vasculum, and a small magnifier, will only cost a few shillings. A few shillings more, for a work descriptive of the plants and of the technicalities of the science, will set up a botanist. This will afford him the means of making his own walks instructive and interesting, and will not merely supply him with a motive for taking exercise in the open air—a practice conducive to his own health and morals—but will place him in a position for materially promoting science, by observing, recording, and communicating natural phenomena to those who are able to make them available, not to the advance of science alone, but to the progress of humanity.

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INTRODUCTION

DEFINITIONS.

1. *Botany*, or Phytology, is the science which treats of the vegetable kingdom in general. It is divided into *structural, physiological, systematic, economical, geographical,* and *descriptive* Botany. *Structural* Botany treats of vegetable anatomy, or the organization of plants. Vegetable physiology treats of plants as organized objects, and as beings capable of certain organic functions. Systematic Botany treats of the arrangement or classification of plants. Economical Botany treats of the uses of plants, in the economy of nature generally, and also of their adaptation to the wants of man, and to the various and numerous orders of the animal kingdom in particular. Geographical Botany treats of the laws which regulate the production and distribution of plants. Descriptive Botany treats of the analogies, affinities, relations, and distinctive characters of divisions, classes, orders, genera, species, and varieties of plants.

STRUCTURAL BOTANY, OR ORGANOGRAPHY—ELEMENTARY OR SIMPLE INTERNAL ORGANS.

2. *The Cell, Cellular Tissue, Forms and Arrangement of.*—The simplest element or first principle of all plants is the cell, a minute vesicle generally of a roundish or egg-shaped form, consisting externally of a very thin membrane (exceedingly fine tissue), replete with juices interspersed with minute granules (small grains) of amylaceous, resinous, or other products, which appear to be peculiar secretions of the vesicles themselves. By mutual pressure these cells usually assume a hexagonal shape, but their figure varies in different plants, and is sometimes variable in the same plant.

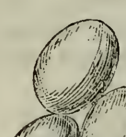


Fig. 1. Appearance of the cells before they assume the hexagonal shape by compression.

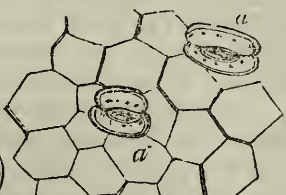


Fig. 2. Appearance of the cells when affected by mutual pressure.

The cells, by union or agglutination or extension, form tubes of greater or less length. These tubes are either placed on each other by their ends, or the ends slightly overlap each other, the membrane disappearing at the point of coherence.

Porous fibrous or *spiral cells* are formed by the disposition of an internal lining formed of the juicy and other matter contained in the interior of the cell, leaving portions of the inside of the cell-wall uncovered, which portions appear more transparent than the covered parts. Fibrous or spiral cells are produced by a similar internal lining of an elastic fibre which is coiled up on the inside of the tubular or elliptical or spherical cell. The development of the cell is one of the obscure subjects of botanical science.

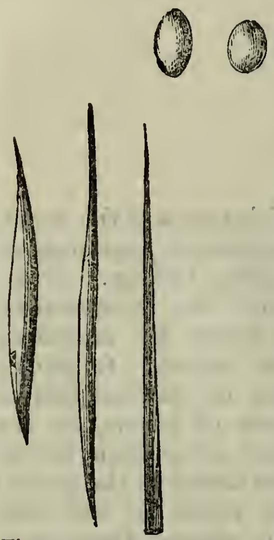


Fig. 3.—Modifications of the cell.

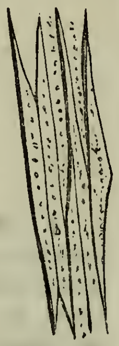
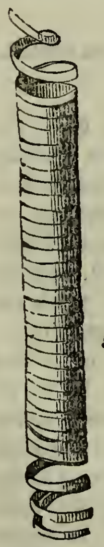


Fig. 4. Porous and fibrous cells.

3. *Vascular Tissue.*—This tissue, which differs from cellular tissue chiefly in form, is divided into—1, *Woody Fibre*, or ligneous tissue. 2, *Fibro-vascular tissue.* 3, *True spiral vessels.* 4, *Spurious tracheæ.* 5, *Porous vessels.* 6, *Lactiferous vessels.* The first of these forms (they are all modifications of the cell) consists of a series of elongated tubes, either cylindrical or tapering (fusiform), adhering continuously, and forming cords, as in flax. These tubes have thick cell-walls, and are disposed in bundles; the solid parts consisting of the stems, fibrous bark, &c.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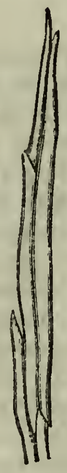
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Fig. 5.—Spiral or fibrous cell. Fig. 6.—Woody fibre, several bundles adhering together.

The second form is less consolidated, or more loosely united than the first form, with a spiral coil on the inside of the cell, or with the interior of the cell marked by rings, dots, for bars. The spirals are complete in the third form, and can be unrolled. These vessels, or true *tracheæ*, are present and obvious in the leaf-stalk of Cabbage, Geranium, &c. Spurious tracheæ consist of separate rings, (somewhat like the segmentary parts of annulated animals), coiled up in the inside of the cell-wall. The fifth form (porous vessels) are cylindrical tubes, in the inside of which the thickening matter is so deposited as to leave part of the membrane uncovered, and thus the whole assumes a dotted or pitted appearance. (See Fig. 7.)

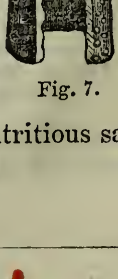


Fig. 7.

The sixth form of the tissue is called the *lactiferous ducts*, a series of branching vessels by which the nutritious sap is conveyed to all parts of the plant. (See Fig. 8.)

They are chiefly found in the under surface of the leaves, and under the bark. These juices are copious in Euphorbias, Poppies, Celandine, &c.

The cellular tissue is the most important elementary organ, both in the vegetable and animal kingdoms. In plants it is universally diffused; every plant contains more or less of this substance; and plants of the lower orders are entirely composed of it. The higher orders of Cryptogams contain ducts (vascular tissue), and hence the Mosses, Lycopods, Ferns, and Equiseta, are named *plantæ ductulosæ* (ductulose plants); but true tracheæ (air-vessels) are not present in any of these. The lower orders of Cryptogams, viz., Liver-worts, Lichens, Funguses, and Algæ (sea-weeds and fresh water Algæ), are without ducts, and hence they are called plantæ eductulosæ (plants without ducts). Every plant in the earliest stage of its growth is solely composed of cellular tissue; and it is only when the plant has made considerable progress in growth that it is capable of producing the higher or more complex kinds of elementary tissues. Nothing can be simpler than the primary elementary principle of vegetative existence. The simple cell is both the original germ and the parent of all the other simple or internal organs. The whole vascular system is derived from the cell; the vascular tissues are similar to the cell, both in structure and chemical qualities, although modified in such various ways as to make them capable of performing the various operations in the economy of the plants to which they respectively belong. The circulation of fluids, both liquid and aeriform, and the various vegetable secretions, are dependent on the vessels or tissues, both vascular and cellular. This is admitted by all physiologists; but the precise functions of each and all of them have not hitherto been satisfactorily ascertained.

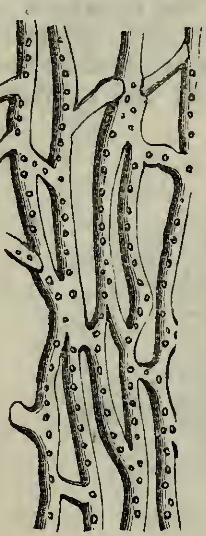


Fig. 8.

4. *The Compound or External Organs of Vegetation* are twofold, and are formed by combinations of the simple or elementary organs, or of the cellular and vascular tissues. There are, 1st, *Organs of nutrition, with their appendages.* 2nd, *Organs of reproduction.* The former of these two grand divisions comprehends the *epidermis*, or usual covering of all the external organs in some stage of their growth,—the *root*, the *stem*, the *leaves*, with their several appendages or appurtenances, such as down, hair, bristles, prickles, spines, scales, horn, &c.

5. *Epidermis and its appendages* (see Index).—This organ is the superficial film or thin pellicle which covers every part of the plant, when in a recent or young state, except certain apertures called the *stomata* (see Index and glossary). It is composed of layers or series or systems of layers, of compressed cells, which here are made to

assume a flattened or tabular shape with flexuous or wavy boundaries, without openings or spaces between the cells, as in the common cellular tissue. It is easily removed from the young plant, or from the recently produced parts of any plant; and it is very conspicuous on the stems of the Birch, which readily parts with its epidermis in all stages of its growth. The stomata, with which the epidermis is always furnished, are openings (apertures) between the epidermal cells. These openings (see Fig. 9) are surrounded or inclosed by two bent or crescent-shaped cells, which open or close the aperture accordingly as the atmosphere is dry or moist. These stomata (mouths or openings) communicate with the intercellular spaces in the interior of the plant, and are generally considered to be the external organs of respiration, *i. e.*, they maintain a communication between the internal organization of the plant and the external air. The number of stomata varies in different plants, and in different parts of the same plant. They are always most numerous on the under surface of the leaves, and are often entirely absent from the upper surface, especially where the leaves are of a coriaceous (leathery) texture, with a dense shining or glossy cuticle, as in the leaves of the Laurel, Rhododendron, Box, and similar-leaved plants. They are not found on any of the cryptogams (flowerless plants), excepting in some of the higher orders, where ducts are present. They are also absent from the submerged parts of aquatic plants, and do not exist on certain parasitic species.

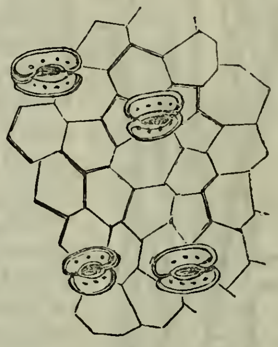


Fig. 9.

6. The epidermis, the root, the stem, and the leaves, are essential organs; the down, hair, bristles, glands, prickles, thorns, &c., are appendages or appendicular organs: the latter are not essential to the existence of plants in general, as the root, stem, and leaves are; for without these, in some form or other, the plant cannot exist—but many plants are without the former. The appendages are no doubt essential to the plants on which they are found; but they are not developed on all plants, and therefore are not essential to all.

The epidermal appendages are—*down*, *hair*, *bristles*, *glands*, *scales*, *prickles*. *Hairs* in plants vary as in animals; being either soft and silky or rough and rigid—either short, like down, or long and wool-like. They are all modifications of some elongation of the cellular tissue of the epidermis; being sometimes a simple prolongation in one piece (1-celled), sometimes forming a series of cells (see Fig. 10, *a c*), sometimes simple, sometimes branched (Fig. 10, *c d*), sometimes erect, sometimes horizontal, at other times depressed. *Prickles* differ from hairs chiefly in being a larger mass of indurated cellular tissue, more or less enlarged at the base, and tapering into a point; *bristles* (setæ), with or without glands, are intermediate between hairs and prickles, being more rigid and stouter than hairs, and not so strong as prickles. Stings are sharp pointed hollow bristles, analogous to 1-celled hairs, but perforated at their tips, and seated on a glandular mass of cellular tissue, wherein the poisonous fluid is secreted. When the hand, or any part of the skin or other object, presses gently against the bristly hairs, then the pressure of the base of the hairs against the gland causes the fluid secreted therein to ascend the tube and enter the skin by the puncture made by the point of the hair or bristle. *Glands* are either sessile (not stalked) or stipitate (with a longer or shorter stalk); they are either single cells or an agglomeration of cells, containing aromatic, saccharine, or other materials, depending on the nature of the plant on which they grow. *Scales* are flat excrescences, also originating in the epidermis; they are common on the stalk (stipe) or midrib of the fronds of Ferns.

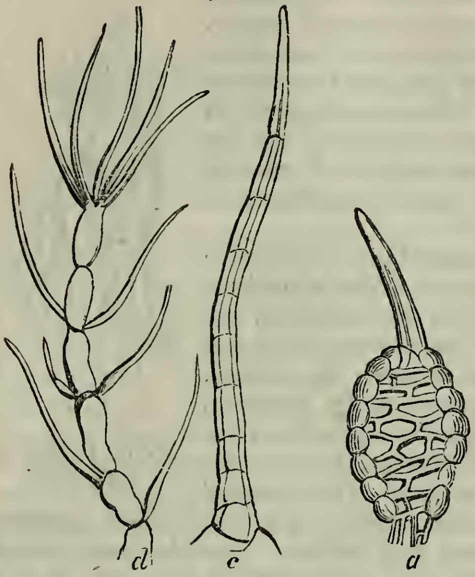


Fig. 10.

7. *The Root and its appendages.*—This organ is the descending axis of the plant, the stem being the ascending axis. It grows downward toward the earth's centre, avoiding the light; the stem, on the contrary, has a tendency to an upward direction, and towards the light. The form of the root is modified by the manner of its growth. When the growth is perpendicular, penetrating deeply into the soil without branching, the tap-root is formed. When this is short and succulent, the conical root, as in Carrot, the fusiform (spindle-shaped) root, as in Radish, or the turbinate (top-shaped) root, as in Turnip, are respectively produced. When the root ends abruptly under the crown (place where the stem and root are connected), the root is called præmorse (bitten off) or truncate (cut across), as in *Scabiosa succisa;* it may be contorted (twisted) as in Bistort. When the root below the crown is divided into a number of fine thread-like divisions, it is called a fibrous root (the roots of grasses are usually fibrous); when these divisions are short and thick (fleshy or succulent), the root is termed fasciculate (Fig. 11); when swollen nodules are developed, the root is *nodulose;* when roundish knobs are produced on the fibres, the root is named tubercular; when these knobs are small, the root is granular. Roots are also globular (round), ovate (egg-shaped), palmate (hand-like), coralloid (coral-like). Most of these latter forms of

the root are exemplified by the *Orchids.* These fleshy tubers, knobs, grains, &c., are appendages of the root, and usually contain more or less of a farinaceous, nutritious substance. When the tap-root produces strong lateral shoots, or if it is divided at some distance below the crown, it is called a branching root. Fibrils are the minute thread or hair-like processes which accompany all sorts of roots; and these are terminated by the spongioles (little sponges), or organs of suction whereby the chief part of the plant's nutriment is imbibed.

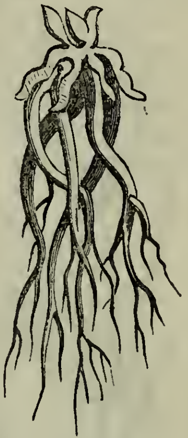


Fig. 11. Fasciculate fleshy root.

8. Roots often afford important distinctive characters of species, genera, and even of orders. The roots of grasses and sedges, for example, are fibrous, and the fibres differ considerably in the respective species of these two orders. In grasses, the fibres are always slender, except in aquatics, and generally tufted, or slightly spreading; in sedges, the fibres are usually thicker, and the roots have a greater tendency to spread. The agrarial grasses (upland and field grasses) except a few called couch grasses, have their roots always fibrous and tufted. The bulbous rooted grasses of dry, sandy, banky places, are only an apparent, not a real exception, for the bulbous part is usually only an enlargement of the lowermost nodule or nodules of the stalk. When the fibres of sedges are much enlarged or fleshy, they are also scaly, and may be regarded as underground stems; the scales are considered to be abortive or rudimentary leaves. In the orders *Cruciferæ* and *Umbelliferæ,* the roots are generally perpendicular, or more or less oblique, or inclining to a horizontal position; they are seldom or never fibrous and tufted. In these two orders they are usually conical or fusiform, or top—or egg-shaped, slightly branched, and fibrous below, generally more or less thick or fleshy, but often hard and woody. The roots are much developed in the cultivated species of Radish, Turnip, Carrot, Parsnep, &c. &c.; in these, the roots have a stem-like structure, and are chiefly distinguished from stems by their greater succulency. The following exceptions to this general mode of development, occur in the following *Umbelliferous* genera, viz., in *Eryngo* (Sea-Holly) *Crithmum, Ægopodium* and *Imperatoria* the roots are creeping, in *Sanicle* thick (fleshy) fibres, in Chervil and Hydrocotyle fibrous, in *Bunium* and *Cicuta* tuberous, in *Oenanthe* mostly tuberous. In *Geraniaceæ,* the roots are usually woody and tapering, rarely tuberous, sometimes spreading, but never tufted. The British Orchids and the European also are distinguished by fleshy roots which are variable in form. The Potato is a tuber produced on the long fibrous roots of *Solanum tuberosum.* The well-known *Arum maculatum* has a knobby, fleshy root, which, when deprived of its acridity, is said to be very nutritious. *Saxifraga granulata* is distinguished

by granular tubercles (small tubers). *Scrophularia nodosa* has thick knobby tubers. *Ranunculus bulbosus* is known by its root, which is bulbous, like a turnip-radish. There are many modifications of this organ besides the above-mentioned, and they will be noticed in the description of species; the above common forms are given to assist the student in learning the terms descriptive of the root in general, and of its varieties and appendages.

9. *The Stem and its appendages.*—In several plants with truncate or præmorse roots, the *caudex* (main trunk of the root) is only slightly extended in a downward direction, so in certain plants the stem is scarcely, or in any perceptible degree developed above ground. These underground stems are not very numerous in the vegetable kingdom; but they do occur, and present a remarkable contrast to the normal or common state of stems which are generally developed above ground. Hence stems are either *subterranean* or *aerial.* The former is distinguished from the true root by its tendency to produce leaf-buds at regular intervals; these are never produced in true roots. The most important forms or varieties of the underground stem are as follow:—The rhizome or root-stock, is a creeping sort of stem, partly underground, producing roots on its under side, and leaf-buds on its upper side. This is exemplified in many of the flag-genus (Iris). The *soboles* is entirely underground, producing roots at one end, and leaves at the other. This form is exemplified by the *Couch-grass, Panic grass, &c. Bulbs* of onions, *corms* of *Crocus, tubers* as the Potato and Dahlia-root, and the *crown* of the root as in the Primrose, are all varieties of the underground stem.

10. *The aerial stem* is distinguished from the underground stem, by being always above ground, and by producing leaves and flowers. In herbaceous plants, which always continue in a more or less soft condition, and speedily decay after producing the fruit, the woody stem is never developed. In trees and shrubs the stem is sometimes of very long duration. An intermediate sort of stem is produced by many plants, connecting the strictly herbaceous with the woody (ligneous) stems. Hence stems are divided into the woody stem (trunk, truncus) of long duration, and the herbaceous stem, or stem of annual duration, and the intermediate form of the stem which is woody at and near the base, and herbaceous in the upper part, the latter perishing annually, the former lasting often for several years. Lavender, Wormwood, Wallflower, and Thyme are examples of intermediate or half-woody stems (suffruticose). The stem of trees is called a *trunk* (truncus), the short stem of a shrub which branches from near the base is called *caudex.* An unbranching stem, as in Palms, is called a *stipe* (stipes). The hollow stalk of grasses is sometimes termed a culm. Stalk (caulis) is a general term applicable to all herbaceous stems. The form of the stem or stalk is usually round and tapering, but in monocotyledonous plants, such as Palms, it is cylindrical. It is not seldom angular, sometimes fluted, and often ridged and furrowed; hence important distinctive marks are derivable from the

stem. The general direction of the stem, or ascending axis of the plant, is vertically upwards; to this, however, there are many exceptions. Some stems are not firm enough to grow or remain in an erect position, and these consequently either cling to contiguous plants or objects for support, or fall to the ground. When the stem is quite prostrate (procumbent), and roots at the leaf-joints, or otherwise, it is called *creeping* or *rooting* (repens); when its lower part rests on the ground, and the upper part is erect, it is called reclining or recumbent; when, like the Ivy, it climbs on trees, walls, rocks, or banks, it is named *scandent;* when like the Honeysuckle, it twists itself round trees or plants, it is called *voluble.*

11. *Internal Structure of Stems.*—All permanent or woody stems of plants which grow naturally in the British Isles, or are capable of enduring the alternations of heat and cold incident to this climate, belong to the Dicotyledonous division of plants—a term which will be explained in the section which treats of the seed. This division of plants is also termed *Exogenous* (see Index and Glossary), a term derived from the structure of the stem, or from the mode in which the successive layers of wood are produced and arranged. The centre of the Dicotyledonous or Exogenous stem consists of a greater or less cylindrical mass of cellular tissue (see Fig. 12). The central portion *a* represents the pith (cellular tissue), which is very large in stems of the first year's growth; *b* is the series of woody layers; and *c* the bark with its hairy epidermis. The pith is surrounded by a ring or tube, composed chiefly of ducts and tracheæ; this tube is called the *medullary sheath.* Between this sheath, or tube, and the epidermis there are two distinct layers formed; the inner one is the woody layer, and the outer one, viz., that between the woody layer and the epidermis, is the bark. These three distinct portions of the stem represented in the cut are the production of one year. In permanent woody stems, a new layer of woody tissue is annually deposited between the bark and the layer of wood formed during the previous year. In successive years, new layers of wood are successively deposited on the outside of the former deposits. The half fluid, or viscous mass of cellular and vascular tissues, with their contents, form annual layers of wood and bark, the latter receiving all its increase interiorly; hence a layer of new wood is formed from the indurated cambium completely investing the former layer, or layers, and a corresponding addition is made to the inner surface of the bark. These annual layers, or concentric rings of wood, are very conspicuous in transverse sections of the common forest and fruit-trees of this country; and the number of such layers is always equal to the number of years of the life of the

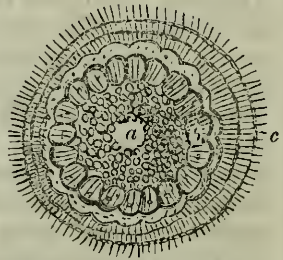


Fig. 12.—A transverse section or slice of Maple (Acer campestre); *a*, the cellular tissue (pith); *b*, the series of woody layers; *c*, the bark.

tree. The pith gradually diminishes by pressure of the surrounding layers, which have a tendency to consolidate the wood; and hence the wood is denser at the centre than at the circumference. The bark, or cortical layers, do not, after a certain period in the age of the tree, materially increase in thickness. Atmospheric influences probably prevent any considerable increase of the bark; for as it is pushed outwards it cracks, and either falls off or is weather-worn. Besides the above-mentioned woody and cortical layers, there is in all dicotyledonous trees a system of radiating layers of cellular tissue connecting the pith and the bark, forming a series of walls wherein the bundles of woody fibre are developed (see Fig. 13). This diagram illustrates the position of the different layers which compose the wood. *a* represents the pith; *b*, the bark; *c c c*, plates of cellular tissue connecting the bark and pith; *d d d*, woody fibres interspersed between, and contained by the medullary rays. The medullary rays are very conspicuous in the Beech and Hazel, and among carpenters are known by the term silver grain. Their use is to consolidate the wood by uniting the several series of vascular bundles to each other as well as to the medullary sheath. Hence there are four characters by which we distinguish the dicotyledonous or exogenous stem from every other woody or permanent stem; viz., 1st, the central pith; 2nd, the concentric rings of wood; 3rd, the bark; and 4th, the medullary rays or radiating layers which connect the medullary sheath with the cambium (see Index).

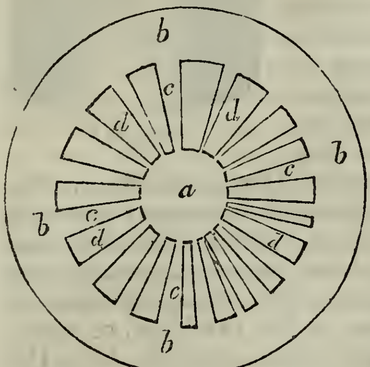


Fig. 13.

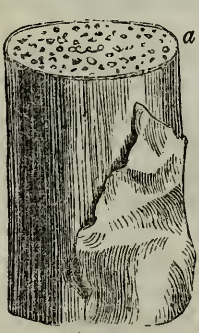


Fig. 14.

12. The *endogenous* or *monocotyledonous* stem is not characterised by any of the above noted marks. The wood is not separable from the pith; but the whole substance of the stem is cellular tissue interspersed with bundles of vascular fibre, distributed in an irregular manner, never disposed in distinct layers. (See Fig. 14, which represents a portion of a monocotyledonous stem.) The surface of the section *a* shows the whole undivided mass of cellular tissue, interspersed with separate bundles of woody fibre. In this kind of stem there are no concentric zones or woody layers, nor is there a distinct bark, neither are there any traces of medullary rays. No examples of permanent or woody stems of this kind grow naturally in our climate; they are mostly confined to tropical and equinoctial regions. The cut (Fig. 15) shows a segment

and section of our common Reed (Phragmitis com:); *a* is the hollow portion, *b* the solid part of the culm, *c* a portion of the sheath.

True *acrogenous* or *acotyledonous* stems are only developed in certain species of the very highest order of cryptogams, viz., in Tree Ferns. They differ from the last described stem chiefly in having less vascular tissue, and by increasing at the summit only, and not in diameter.

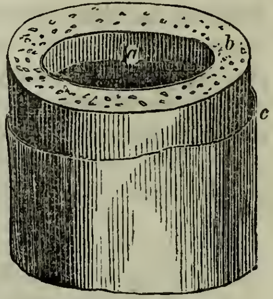


Fig. 15.

13. The stem, which is the connecting medium of the root and leaves, and bears the branches (when present) and the organs of fructification, is one of the most important organs in the economy of the plant. By the structure and development of this part the three grand divisions of plants are distinguished from each other. The whole vegetable kingdom, with the exception of *Amphigens* (comprehending the Lichenes, Fungi, and Algæ), is divided into *Acrogens*, *Endogens*, and *Exogens*. In *Acrogenous plants*, the stem increases only at its point or extremity, not in its diameter. In *Endogenous plants*, the increase of the stem is internal; that is, the cambium, or whatever it is that forms the bundles of woody fibre, proceeds from the leaves, and penetrates the softest part of the stem, which is its interior, these fibres are arrested at the circumference, which is by far the densest portion of the stem, and prevents increase in that direction. The *exogenous stem* increases externally, as has been already shown (Sec. 11). In *Acrogens* and *Endogens* the stem is simple (unbranched); in *Exogens*, the stem is usually branched. Buds are generally produced in the latter-mentioned stems, but rarely in the former.

Several orders are distinguished by the stem; for example, the structure of the stem in the *Coniferæ* (Pine-tree family) is different from that of all other exogenous stems, in being without medullary rays; and in the young stem the branches are always whorled (radiating from the same point of the stem). In the following orders the stems are prostrate, climbing or twining; viz., *Fumariaceæ*, *Leguminiferæ* and *Rosaceæ* in part; *Cucurbitaceæ*, *Araliaceæ*, *Apocynaceæ*, *Convolvulaceæ*, *Solanaceæ*, and *Scrophulariaceæ* in part; *Polygonaceæ* and *Aristolochiaceæ* in part. Certain genera bear strong shoots the first year, which shoots bear flowers and fruit the second year, as Rubus. Several genera, like *Fragaria* (strawberry), produce prostrate, creeping stems. Woody stems distinguish the orders, *Berberidaceæ* in part, *Rhamnaceæ*, *Celastraceæ*, *Grossulariaceæ*, *Araliaceæ*, *Cornaceæ*, *Loranthaceæ*, *Caprifoliaceæ*, *Ericaceæ*, *Ilicineæ*, *Aquifoliaceæ*, *Oleaceæ*, *Apocynaceæ*, *Eleagnaceæ*, *Thymeliaceæ*, *Empetraceæ*, and portions of *Leguminiferæ* and *Solanaceæ*. Several *Labiatæ* are furnished with half-shrubby stems; also a few *Cruciferæ*, most of the order *Cistaceæ*, and several *Euphorbias*. Coni-

feræ and *Amentiferæ* comprehend most of our forest trees. Some orders have usually hollow stems; viz., *Ranunculaceæ* and *Leguminiferæ* and *Dipsaceæ* in part; most of the *Umbelliferæ*, all the *Gramineæ* and *Elatinaceæ*; and a portion of the *Compositæ Juncaceæ.* The pith is largely developed in the shoots of *Roses, Brambles, Elder,* many of the *Rushes,* and in a large portion of the *Cyperaceæ.* The stems in *Labiatæ,* and in sub-order *Stellatæ,* are quadrangular, and chiefly so in *Lythraceæ, Onagraceæ* and *Gentianaceæ.* In *Cyperaceæ* the stems are usually triangular. Some genera have fluted stems, as *Rubus.*

14. *Leaves* are more or less thin, flattened expansions, consisting of bundles of vascular tissue, which bundles constitute the skeleton or frame-work of the leaf; the more prominent bundles are called nerves, and the smaller ones veins or veinlets; their disposition in relation to each other is called nervation or venation. The shape or outline of the leaf depends on, or is modified by, the length and relative position of the nerves. When the middle, or principal nerve (an extension of the bundle of fibres forming the petiole, or leaf-stalk if present) divides into branches, and when all the branches diverge in the same plane, the leaf is flat, and this may be called the normal state of leaves, (Fig. 16); when the nerves diverge in different planes, the leaf is orbicular (round) as the leaf of common sheep-rot (Hydrocotyle vulgaris.) (Fig. 17.) In succulent or fleshy leaves, such as the leaf of the *House-leek, Sedum,* several *Pinks,* &c., the nerves spread in different planes, and the *parenchyma* (cellular tissue) is so much developed as to conceal the nerves, which consequently are neither prominent nor visible, as they are in the greatest number of leaves. The leaf when complete consists of two parts (Fig. 18,) *a,* the *petiole,* or leaf-stalk; *b,* the *lamina* or blade. The petiole connects the leaf with the branch or stem, and is composed of the unexpanded bundles of fibres, covered by the epidermis; the ramification of the nerves constitutes the skeleton, and the veins and veinlets, with the cellular tissue and epidermis, constitute the entire leaf. When the petiole is not present, the leaf is termed sessile. Sessile leaves often partially or entirely surround the stem, and in this case they are termed *semiamplexicaul* or *amplexicaul* (half embracing, or quite surrounding the stem.)

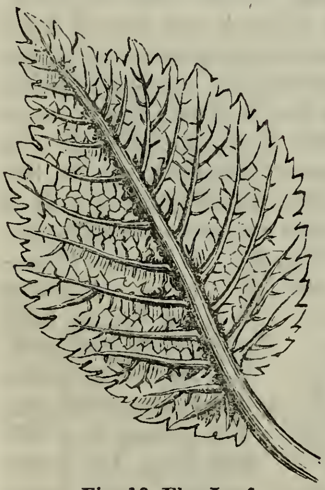


Fig. 16. Elm Leaf.

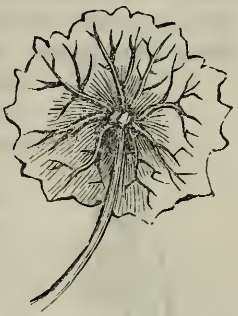


Fig. 17. Leaf of Hydrocotyle vulgaris.

15. The most obvious division of leaves is into *simple* and *compound.* In simple leaves the limb consists of one piece, either quite entire, or variously indented, cleft or divided at the margin. (See Fig. 18, an entire leaf; 17, a crenate, and 16, a toothed or incised leaf.) Compound leaves are composed of one or more pieces, called leaflets, each of which is jointed to the common petiole or rach, as it is termed when the leaf is winged. (See Fig. 19, which represents a pinnate, or winged leaf.)

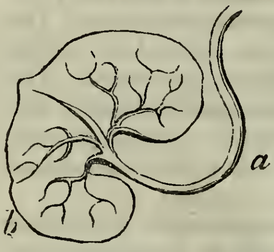


Fig. 18.

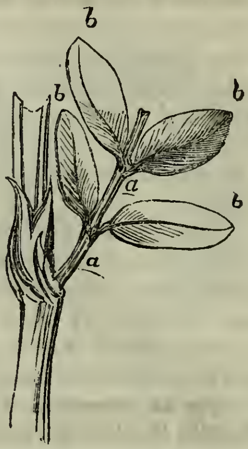


Fig. 19.—*a* the rach, *b b b b* the four leaflets of the compound leaf.

16. *Simple leaves.*—It has been stated that the shape or contour of the leaf is regulated or modified by the angle of divergence of the lateral or secondary nerves (the branches of the principal or median nerve), and by their length. When the divergent nerves are but slightly distant, and extend from the base to the apex, inclosing only a narrow slip of parenchyma, the leaf is called *linear.* The leaves of grasses are familiar examples of this form. When the nerves extend from end to end, and are rather more distant in the middle of the leaf, the *lanceolate* form is produced. In these two forms the nerves usually diverge at the base, but in the second, viz., the lanceolate form, the relative length of the secondary nerves, and their wideness of angle produce a *lanceolate leaf.* (See Fig. 20). When the secondary or branching nerves are nearly of equal length, both at the base and apex, the leaf is elliptico-lanceolate. (Fig. 21.) The oblong leaf differs from the latter merely in being rather broader at the base and tip. (Fig. 22.)

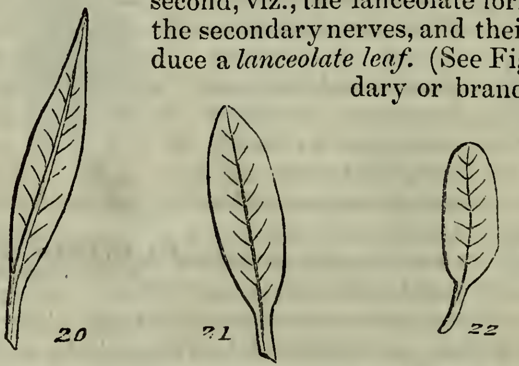


Fig. 20. Lanceolate leaf with branching nerves.—Fig. 21. Elleptico-lanceolate leaf.—Fig. 22. Oblong leaf.

When the branching nerves are nearly equal, the leaf being obtuse at both ends, it is called a *rounded leaf.* (See Fig. 23.) This form, which is also termed orbicular, must not be confounded with the leaf of Hydrocoytle vulg. Fig. 17. In this latter the leaf is peltate (pelta a buckler); the nerves do not diverge in the same plane; in Fig. 23 the nerves do diverge in the same plane.

If the leaf be rounded at the base, and tapering at the top, having the basal nerves longest, it is called ovate (Fig. 24). If the upper nerves be longest the leaf is obovate (inversely egg-shaped), (Fig. 25).

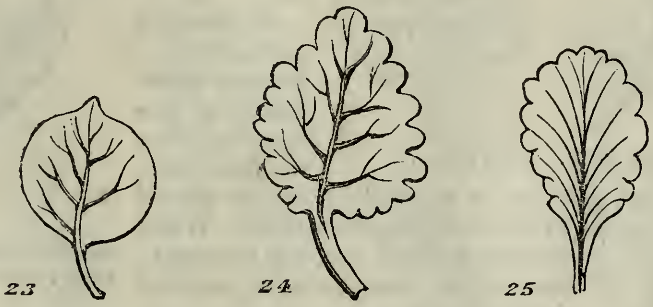


Fig. 23. Rounded leaf.—Fig. 24. Ovate, lobed, or toothed leaf.—Fig. 25. Obovate, crenate, or crenated leaf, tapering downwards into the petiole.

The cuneate, or wedge-shaped leaf, is a slight variety of the last, with the apex flatter (less rounded).

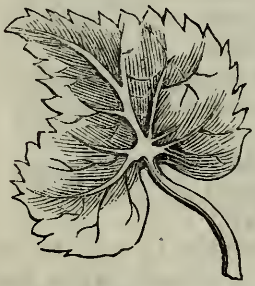


Fig. 26. Cordate acuminate leaf.

If the basal nerves be prolonged downwards, forming obtuse angles with the middle or primary nerve, the cordate or heart-shaped leaf is produced (Fig. 26).

When the secondary nerves are unequal, and diverge at unequal angles, the leaf is unequally cordate (Fig. 27).

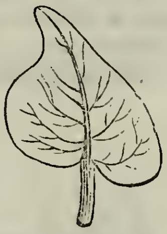


Fig. 27. — Unequally cordate acuminate leaf.

When the lateral nerves exceed the median nerve, and the basal nerves are reflexed at very wide (obtuse) angles, the leaf is *reniform*, or kidney-shaped (see Fig. 28).

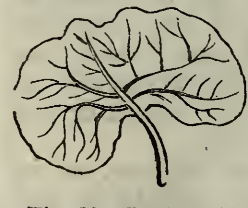


Fig. 28.—Leaf of *Asarum europeum.* Reniform leaf.

When the parenchyma is deficient at the apex, and the upper lateral nerves longer than the lower, the leaf is obcordate (Fig. 29).

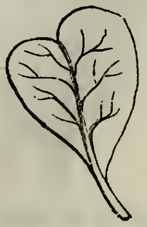
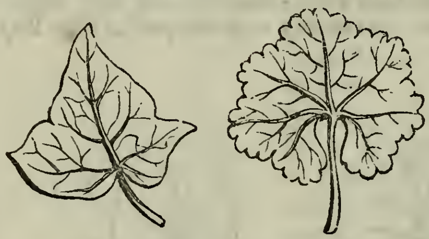


Fig. 29. Obcordate leaf.

When the petiole separates at the base, and forms several nearly equal nerves, each of which is furnished with lateral nerves, the leaf is lobed, as the Ivy-leaf, Mallow-leaf (Figs. 30, 31).

16. *Margin or edge of the leaf.* — When the margin of

the leaf is free from notches, scollops, indentations, teeth, lobes, &c., it is called entire (see Fig. 32).



Figs. 30, 31. Lobed leaves.

When the parenchyma is more developed at the margin than in the plane of the leaf, the leaf is *undulate*, *crisp*, or *curled* at the edge, as in many of the *Dock genus*. When there is a slight notch at the apex, the leaf is *emarginate* or *notched* (see Fig. 33).

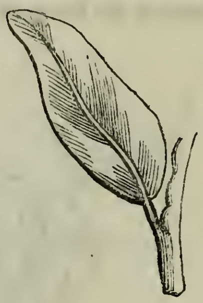


Fig. 32. Margin quite entire, slightly wavy.

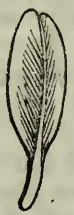


Fig. 33. Notched elliptical leaf.

When the margin is furnished with rounded projections, the leaf is *crenate* or *crenated* (see Fig. 34).

If the projections be very small, and the incisions very shallow, it is *crenulate* (Fig. 17).

If the projections be longer and sharper, and more or less divergent, the leaf is *toothed* (dentate), (Fig. 16).

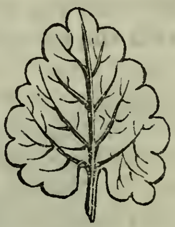


Fig. 34. Cordate crenate leaf.

If the teeth be sharp and pointed upwards, the leaf is *serrate* or *serrated*, having teeth like a saw (Fig. 35).

When the teeth are serrated, the leaf is called doubly serrated (Fig. 36).

The margin is said to be *flexuous* or *sinuate* when the projections are slight and far apart (Fig. 28). When the margin is divided half-way to the midrib the leaf is *pinnatifid* (Fig. 37); and when the lobes are more or less divided, the leaf is doubly pinnatifid, or pinnatifid with incised or cut lobes (Fig. 38).

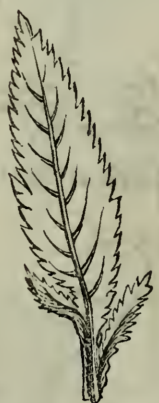


Fig. 35. Serrated auricled leaf.

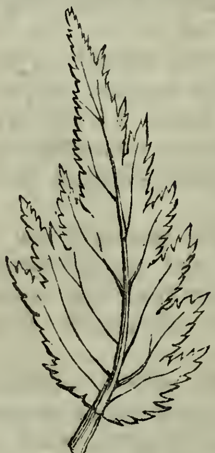
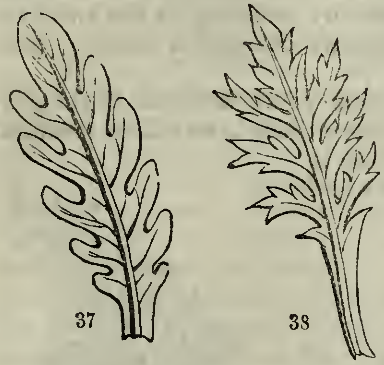


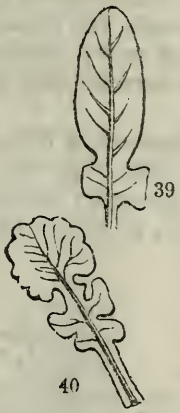
Fig. 36. A doubly-serrated ovate acuminate leaf.

When the incisions, as in Fig. 38, reach close to the mid rib, the leaf is *parted* (partite). When there is only a pair of lobes, one on each side at the base, the leaf is *hastate* (sword-shaped), or *auriculate* (with little ears or projections), (see Fig. 39).

The *lyrate* or *panduriform* (fiddle-shaped) leaves differ from the hastate leaf chiefly in having the sinus or unfilled portion of greater extent, and further from the base (see Fig. 40).



Figs. 37, 38. Pinnatifid and doubly pinnatifid leaves.



Figs. 39, 40. Hastate and Lyrate or panduriform leaves.

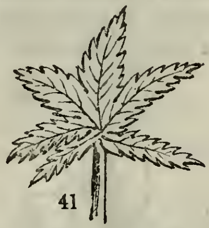


Fig. 41. Palmate or hand-like leaf.

When the nerves divide in a radiating manner from the base, and when the margin is deeply incised, or lobed, the leaf is *palmate* (hand-like) (see Fig. 41).

Compound Leaves.—The essential distinction between the simple and the compound leaf is, that the former may be, and often is, sessile; that is, it is united to the branch or stem on which it grows without the intervention of a leaf-stalk (petiole); the compound leaf is never sessile. Again, the distinct parts of the compound leaf are jointed to the petiole; the lobes of the simple leaf, however deep the incision be, always form integral parts of the leaf. The leaflets of a compound leaf may be detached without tearing the substance of the leaf; the lobes of a simple leaf cannot be detached without

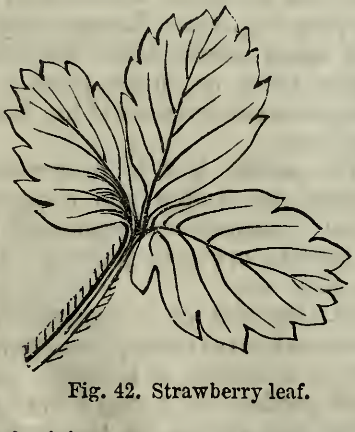


Fig. 42. Strawberry leaf.

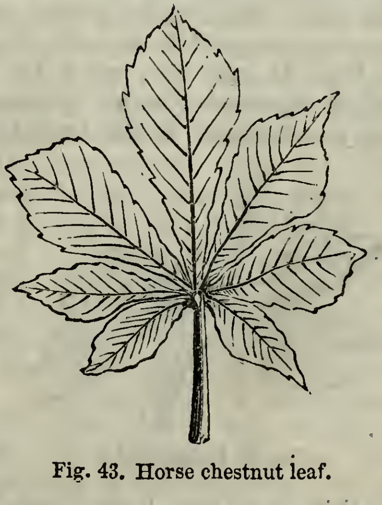


Fig. 43. Horse chestnut leaf.

laceration. A compound leaf may have one leaflet or an indefinite number; but every leaflet must be jointed to the common petiole, or rach. The compound leaf is either *ternate* (like Trefoil or Strawberry), Fig. 42. The *quaternate*, the *quinate*, and the *septenate* forms of the compound leaf may be easily understood by referring to the two cuts which represent the ternate and septenate compound leaves. (See Figs. 42, 43).

18. One of the commonest forms of the compound leaf is the *pinnated* (winged) leaf. (See Fig. 44.) When there is no odd or terminal leaflet, it is equally pinnate; when there is an odd or terminal one, as in cut 44, the leaf is unequally pinnate. When there is an abortive or minute leaflet between the lateral leaflets, the leaf is interruptedly pinnate. (See Fig. 45.) When there is only one series of leaflets on each side of the common petiole or rach, the leaf is simply or singly pinnate (as in Figs. 44 and 45); when the branches are again subdivided, the leaf is *bipinnate* (doubly pinnate). (See Fig. 46.) Leaves may be triply compound if the branches be again subdivided. They may be also twice or thrice ternate by subsequent subdivisions of the lateral branches.

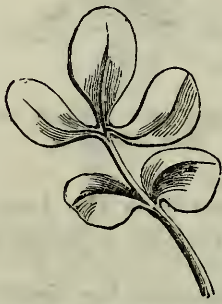


Fig. 44. Pinnate, with an odd terminal leaf.

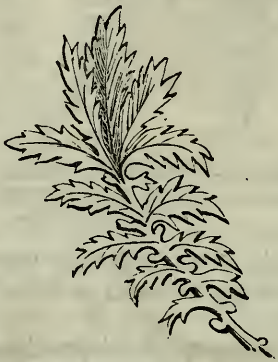


Fig. 45. Interruptedly pinnate leaf.

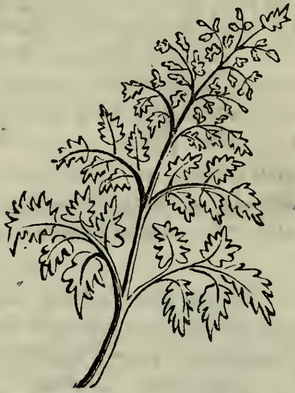


Fig. 46. Bipinnate or compound leaf.

The *pedate* leaf is intermediate between the simple and compound leaves. The petiole is branching, but the leaflets are not jointed. (See Fig. 47.)

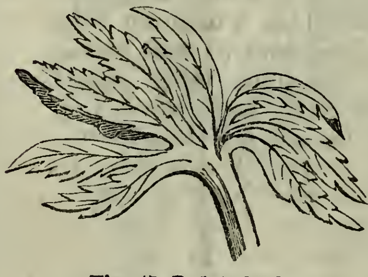


Fig. 47. Pedate leaf.

19. *Position or Arrangement of Leaves.*—Leaves occupy various positions on the stem or branch. Some plants produce only root leaves, and in this case the leaves grow from the crown of the root, or under-ground stem, and are usually disposed in what is termed a *rosette* (arranged somewhat like the petals of a double rose). When

two leaves are produced from the same point of the stem, and on opposite sides of it, they are called *opposite*. In some genera and species, the opposite leaves are also *connate* (growing together by their bases). When more than two leaves are produced at the same point, the leaves are *whorled* or *radiate* (verticillate). (See Fig. 48.) When the leaves are produced on opposite sides of the stem, but not from the same point, they are *alternate;* if disposed irregularly, neither opposite nor alternate, they are *scattered.* If there be many leaves, the stem is leafy; if there be none, or very few, it is leafless, or nearly so. When, by the non-extension of the branch or stem, the leaves are in approximation to each other, they are *tufted,* or *fasciculate.* When closely arranged along the stem in two rows, they are *distichous*; and when contiguous, and so arranged as to cross each other in four rows or ranks, they are *decussate.* The leaf is *decurrent* when its midrib passes down the stem or branch. (See Fig.49). It is *perfoliate* when the lobes of the base unite and embrace the stem. (See Fig. 50.)

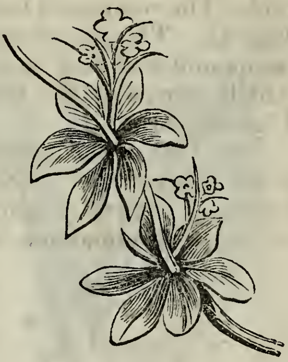


Fig. 48.

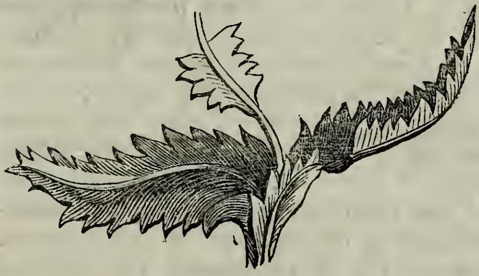


Fig. 49.

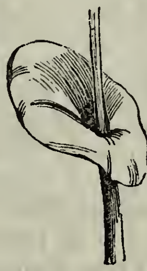


Fig. 50.

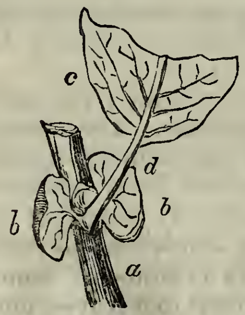


Fig. 51.

20. *Appendages of Leaves.*—Several of these have been already described under the section Epidermis and its appendages, viz., prickles, glands, setæ (bristles), hair, &c. The most important of those remaining to be described are—*stipules, tendrils,* and *thorns.* In Salix (Willow) and some other plants, the stipule is like a small leaf. (See Fig. 51). *a* is the stalk or branch, *b b* the stipules, *c* the leaf, and *d* the petiole. The stipules may be united as in the Roses. (See Fig. 52.) *a* is the branch, *b* the compound leaf, *c c* the stipules, cohering to each other and to the petiole, by their edges, forming a petiolary stipule. The order Polygonaceæ is characterised by the universal presence of membranous sheaths, which are a sort of stipule, or appendage of the leaf. The Gramineæ have a scarious crown above the sheath,

which is named a *ligule.* (See Fig. 53.) *a* the sheath, *b* the blade of the leaf, *c* the ligule. In *Umbelliferous* plants there is a loose sheath at the base of the petiole, which embraces the branch or stem, and is termed *pericladium.* In *Ranunculaceæ* the petioles are sheathing.

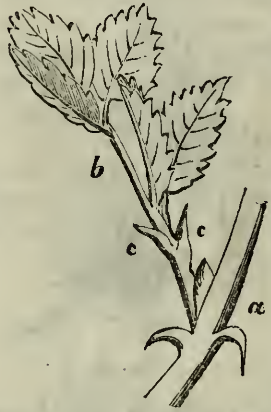


Fig. 52.

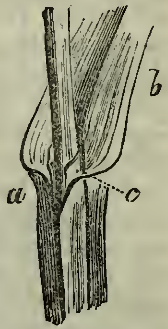


Fig. 53.

Tendrils are a prolongation of the common petiole, and are common in Leguminiferous plants, as the Pea, Tare, &c.; and when the tendril is present there are usually fewer leaflets; and there cannot, in this case, be a terminal or odd leaflet, which, in other cases, usually terminates the growth of the petiole or rach. In several species tendrils appear to be metamorphosed leaflets, as in the Pea, the Vine, &c. The tendril is either simple or branched, but always curls or coils up. *Thorns* are often metamorphosed (changed) or abortive branches; but in some cases, as in the common Berberry and Furze, they are abortive stipules or leaves, such abortion being caused by the deficiency of parenchymatous matter.

21. *Vernation or Prefoliation of Leaves.*—Before the leaves expand they are closely folded up in the leaf-bud, and their state when so folded is called vernation, or prefoliation. When the plaits or folds are disposed parallel to the midrib, the prefoliation is longitudinal. This mode of prefoliation is exemplified by the Grasses. When so folded as that the apex and the base approach, the prefoliation is *transverse.* If rolled up, as in Ferns, from the apex to the base, it is *circinate;* if folded like a fan, *plicate.* When rolled inwards or outwards it is *involute* or *revolute;* as Violet and Rosemary, Dock, &c. When they simply touch each other in the bud, they are *valvate,* and when they overlap each other, they are *imbricated* (tiled). When they cover each other, they are *conduplicate* or *equitant,* as in the Iris (Flag). These positions are also common to the flower-bud.

Leaf-buds are both terminal and lateral; by the former, the stem or branch is prolonged; by the latter, it grows thicker. The lateral buds are always situated in the angle of the leaf and stem, or branch. Buds not subtended by a leaf are called anomalous buds, being of rare occurrence.

22. *Importance of Leaves in distinguishing Divisions, Classes, Orders, Genera, and Species of Plants.*—The two grand divisions of Flowering Plants can be readily known from each other, either by the nervation, the structure, the outline, or the articulation of the leaf—generally by one, but usually by all of these characters conjointly taken.

In monocotyledonous plants the nerves of the leaf are parallel, as in *Gramineæ* (grasses). (See Fig. 54). In dicotyledonous plants the nervation is never parallel, but more or less divergent and branched. (See Figs. 16, 18.) The nerves are not always parallel in Monocotyledons, but they do not branch, and when connected by veins or veinlets, these are usually straight and parallel to each other, not crooked and divergent, as in Dicotyledons. In the former the leaves are always simple and entire at the margins; in the latter they are frequently compound, and seldom quite entire. In Monocotyledons the shape, figure, or contour, is linear, like grass, or some modification of this form; in Dicotyledons the leaves are multiform (of many shapes). In the latter the leaves are distinctly articulated to the stem; in the former this is rarely the case. In *Dictyogens*, a small division intermediate between *Endogens* (Monocotyledons) and *Exogens* (Dicotyledons), the leaves have branching nerves, but the leaves in these plants are simple, and of regular outline. The following orders are distinguishable by their leaves:—*Gramineæ* and *Cyperaceæ* by linear, narrow leaves; the former (Grasses) have slit sheaths, the latter (Sedges) have the sheaths usually entire. *Ranunculaceæ* for the most part have divided leaves, with sheathing petioles. *Umbelliferæ* have generally compound leaves, which are pinnate, bipinnate, or tripinnate; or ternate, or biternate, or triternate; they have also a broadly sheathing petiole. *Leguminiferæ* have usually compound leaves, which are either ternate or pinnate. *Rosaceæ* is also generally distinguished by its compound leaves, which are either ternate, or quinate, or pinnate, or interruptedly pinnate. Narrowly linear and sharp-pointed leaves distinguish *Coniferæ.* Many plants are distinguished by the position of their leaves. In the Primrose genus the leaves are all radical. This is the case generally in the orders *Droseraceæ*, *Gentianaceæ*, *Lentibulaceæ*, *Plantaginaceæ*, *Plumbaginaceæ*, and in several genera and species of *Compositæ*.

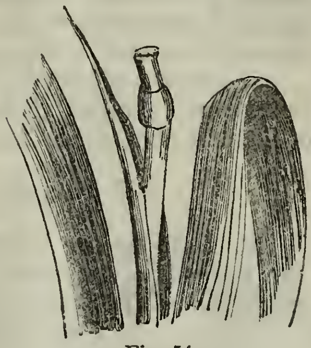


Fig. 54.

The following orders have opposite and mostly simple leaves, viz., *Labiatæ*, *Verbenaceæ*, *Gentianaceæ*, *Oleaceæ*, *Apocynaceæ*, *Valerianaceæ*, *Dipsaceæ*, *Caprifoliaceæ*, part of *Primulaceæ*, most part of *Lythraceæ*, *Hypericaceæ*, *Elatinaceæ*, *Frankeniaceæ*, *Caryophyllaceæ*, *Cornaceæ*. Sub-order *Stellatæ* and part of *Ericaceæ*, have whorled leaves. The following orders have stipulate leaves, viz., *Polygonaceæ* (ochreate or booted), *Amentaceæ*, *Urticaceæ*, *Resedaceæ*, *Euphorbiaceæ*, *Leguminiferæ*, *Rosaceæ*, *&c.* The following orders contain plants bearing tendrils:—*Cucurbitaceæ*, *Tamaceæ*, *Fumariaceæ*, and *Leguminiferæ*.

Certain orders are distinguished by their prefoliation (state of leaves before expansion). *Filices* and *Droseraceæ* are circinate (curled inwards from the base like a crook). In *Grossulaceæ* and *Malvaceæ*, the prefoliation is plicate (folded like a fan). In some orders the principal nerves diverge from the base in a radiating manner; for example, *Geraniaceæ*, *Aceraceæ*, *Malvaceæ*, *Grossulaceæ*. In many *Amentiferæ*, and in the genus Ulmus the lateral nerves are parallel.

Genera are often determinable by the number of leaflets in their compound leaves, as Trefoil, &c., and some by the presence or absence of the odd or terminal leaflet.

ORGANS OF REPRODUCTION.

23. *Inflorescence* is the arrangement of the flowers on the axis. The axis of inflorescence is either *simple* or *branching*, *definite* or *indefinite*. It is simple when the flowers are arranged on separate pedicels, as in the annexed cut, *Berberis vulgaris*. (Fig. 55.) *a* is the rach or common peduncle, *b* the pedicel (flower-stalk), *c* the flower. In the cut (Fig. 56) the flowers are spiked, and consequently sessile (without pedicels). The rach is the stalk prolonged. *a* the stalk, *b* the fertile spike or catkin, *c* the barren spike or catkin. The axis is compound, *i.e.* branching, when the lateral flower-stalks bear several flowers, each lateral stalk becoming a secondary axis, and producing flowers and pedicels. The stalk of an individual flower is usually called the peduncle, but in examples of simply clustered flowers (as in Fig. 55), it is more convenient to call the central stalk, which bears only lateral peduncles, and no flowers, except at the very top, the *peduncle* and the lateral flower-stalks pedicels. Pedicels and peduncles are terms used in expressing the medium between the flower and the stalk, or branch; but pedicel is always restricted to that part which bears only a single flower; while peduncle is also applied to the part which bears single flowers, though it is also employed to designate the part which bears both pedicels and flowers.

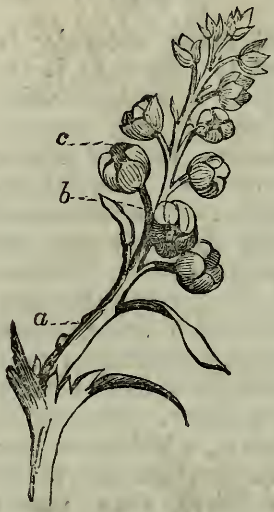


Fig. 55.

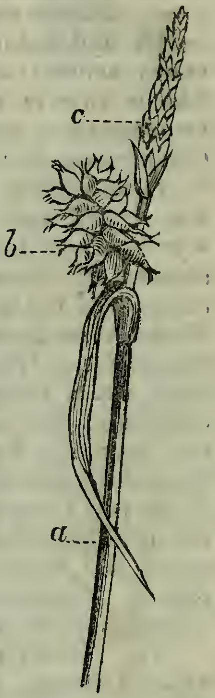


Fig. 56.

24. The termination of the pedicel, or peduncle, when it bears a single flower, is called the *torus*, or *thalamus*, and when expanded into a broad, flat, elevated, or concave disc, it is called the *receptacle*.

This part is much developed in the *Compositæ*. In the *Geraniaceæ* it is prolonged beyond the flower, forming a *beak*. In the orders *Araceæ* and *Typhaceæ* it is a club-shaped or a more or less fleshy column. In the Strawberry it is large and succulent. In the *Potentillas* it is dry and conical. Inflorescence is *definite* when the axis ends in a single terminal flower. The inflorescence of all single-flowered plants is definite, as for example the *Tulip*, the *Anemone*, &c. But many plants which produce several flowers are also definite or determinate, as *Ranunculus bulbosus*. (Fig. 57). *a* is the terminal blossom which ends the growth of the central stem, and the lateral flowers *b b* are subsequently expanded. The inflorescence commences at the centre and extends to the circumference; hence it is termed *centrifugal.* The inflorescence is indefinite when it commences at the base, and gradually extends up the stem, and goes on flowering so long as the axis lengthens, which extension of the axis is dependent on the capability of the plant to increase its axis of growth, and is consequently indefinite. This property is very obvious in *Verbena officinalis*. (Fig. 58). At *a* the fruit is formed, at *b* the flowers are expanded, and at *c* they are unexpanded; but they will continue opening as long as the axis continues to grow.

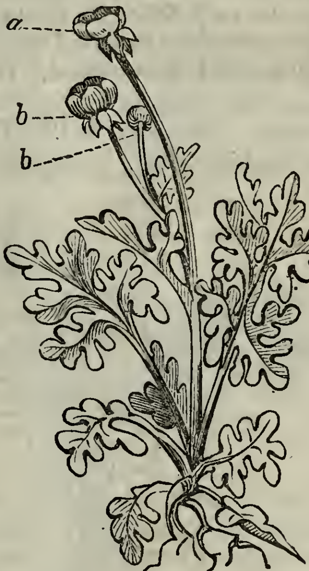


Fig. 57.

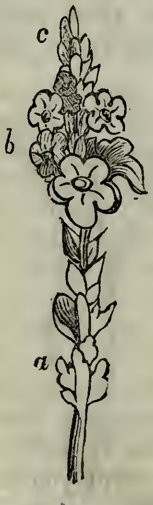


Fig. 58.

In the *Evening Primrose* and the spiked-flowered *Veronicas* this expansion of the flowers from the base to the apex, in an indefinite manner, is very obvious. This inflorescence is termed *centripetal.*

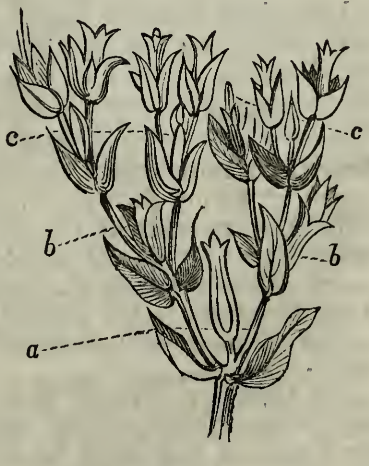


Fig. 59.

One of the commonest forms of the definite or determinate inflorescence is the Cyme (Fig. 59) *Erythræa Centaurium*. The stem terminates in the axillary flower *a*, and gives out a pair of branches under the flower; these branches terminate in axillary flowers *b b*, and give out secondary branches below the respective flowers; these secondary branches again terminate in tertiary axillary florets *c c*. This mode of inflorescence is common in *Caryophyllaceæ* In some plants, as Privet, for example, the Cymes are arranged in a panicle. The simplest form of the indefinite inflorescence is the spiked or spike-like inflorescence. (See Fig. 58). The cluster or raceme differs from the spike in having the flowers pedicelled, not sessile, as in the spike. (See Fig. 55). The cluster, like the Cyme, is often panicled (branching, every branch forming a lateral axis on which the flowers are developed indefinitely, the lowermost or outermost first, and the upper in succession). When the lower peduncles are lengthened, and the upper shortened, so as to bring the flowers nearly to the same horizontal level, the inflorescence is called a *Corymb.* The Corymb may be either simple or compound, according as the lateral or lower peduncles are simple or compound. In umbelliferous plants the primary axis is shortened, so that the secondary axis or lateral peduncles originate in the same point, and are about equal in length. If these branches divide again, and form similar umbels, the whole is a compound umbel. (See Fig. 60). *i*, bracts of the common involucre; *p*, the point of the very much shortened axis; *b*, the primary branches; *c*, the secondary umbels.

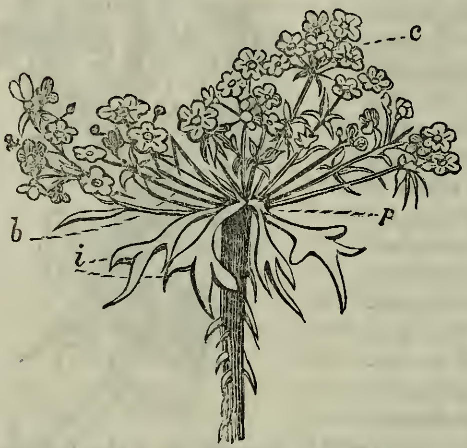


Fig. 60.

In compound flowers the axis is shortened and expanded, and the inflorescence is a *capitulum* (head). (See Fig. 61).

In *Myosotis palustris* the inflorescence is called *gyrate.* (See Fig. 62).

For other modes of inflorescence, see Index.

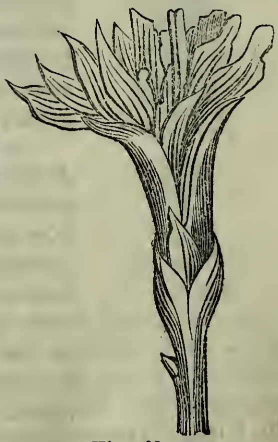


Fig. 61.

25. *Organs of Reproduction.*—The flower and its appendages are distinguished from the organs of vegetation by their position, structure, and use. They are usually situated on the upper parts of the plant; they are generally of a more delicate structure, remarkable for their elegance, beauty, brilliancy of colour, or exquisiteness of perfume.

Their use is to terminate the growth of the plant in the direction where they are situated, and it is by their agency that fruit or seed is produced, and the continuation of the species or race provided for. The flower is composed of the *floral envelopes*, as they are called, and of the *stamens* and *pistils ;* the latter are called essential parts of the flower, the former are non-essential parts; and in some species, genera, and orders, some or all the floral envelopes are absent. The stamens and pistils are not always in juxta-position, but they are always present, either united in the same flower, or distinct and distant from each other on the same plant, or on distinct plants. The floral envelope is usually, but not always double; sometimes there is only a single envelope present. The outer one is called the *calyx*, the inner one the *corolla*. Between the vegetative organs which have been described, and the reproductive organs which are now the subject of description, there is an intermediate system of organs termed *bracts*. These are distinguished from leaves usually by their position (contiguous to the flowers) often by their structure, as membranous or scarious ; by their arrangement, which is often symmetrical. In *Malvaceæ*, *Convolvulaceæ*, and in some genera of *Rosaceæ*, the bracts are similar to the calyx, both in arrangement and structure, and are often denominated a secondary calyx, or lower or outer calyx. In *Dipsaceæ* and *Compositæ*, they are arranged symmetrically, forming a sort of tiled or overlapping cover to the aggregate flowers. In *Umbelliferæ*, they are radiate or whorled. They are of great importance in the economy of the Compositæ, inasmuch as they converge after the period of flowering, and form a protective cover to the fruit. In many cases they afford distinctive generic and specific characters.

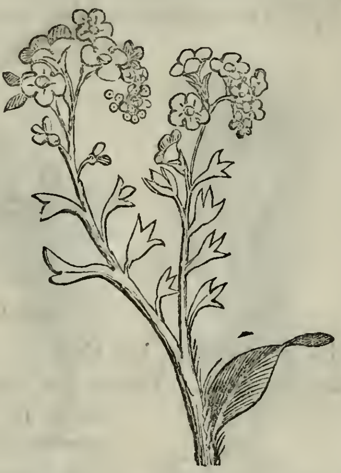


Fig. 62.

26. *Calyx.*—This organ is usually the outer envelope of the flower, and consists either of a whorl, or series of leaflets (sepals), either diverging, or connivent, either horizontal, erect, or reflexed. See Fig, 64; *a* the calyx, *b* the corolla. When the sepals or leaflets are united, either at their base or throughout, the calyx is usually called *monosepalous* (gamosepalous is a more expressive term; see *Index.*) When the sepals are not united (coherent) the calyx is *polysepalous*. The united portion of the calyx is called the tube, the free, or spreading part, the limb, lobes, segments, or teeth. It is said to be cleft when the incisions are not deep, and parted when they extend nearly to the base. When the adherence is irregular, either in the number of sepals connected, or in the extent of the cohesion, the calyx is irregular, either two-lipped (*labiate*)

(Fig. 65), or *ringent* (gaping). The form of the sepals is various, but commonly elongated, lanceolate, tapering (Fig. 63), either blunt or pointed, and nearly always sessile, *b* the peduncle, *a a a a a* the sepals, or segments of the calyx. They are usually green or some shade of green, but they are occasionally beautifully coloured, as in the Fuschia. The calyx, like the sepals, is usually more or less uniform in shape; the usual modifications are the *prismatic*, as in *Primula* (Fig. 67), the *globular*, the *funnel-shaped*, the *turbinate*, like a top, the *inflated* (Fig. 66).

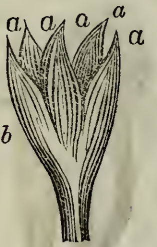


Fig. 63.

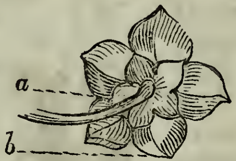


Fig. 64.

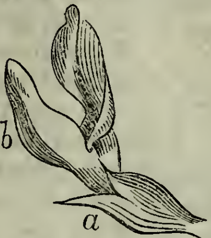


Fig. 65.

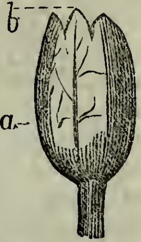


Fig. 66.

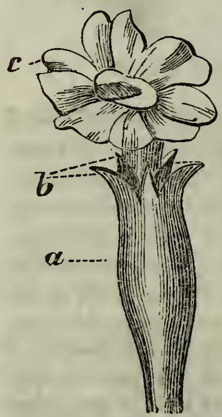


Fig. 67.—*a* the calyx tube; *b* the lobes or teeth of the calyx; *c* the corolla.

In some families—viz., *Compositæ*, *Umbelliferæ*, &c., the calyx is rudimentary, or a small inconspicuous rim or minute teeth. In *Pomaceæ* and *Grossulaceæ*, the calyx adheres to the pistils, and becomes part of the fruit (Apple and Gooseberry). In *Papaveraceæ*, and the greatest part of Ranunculaceæ, the calyx is deciduous.

27. *The Corolla.*—This organ, the usually more or less coloured inner or upper envelope, or floral verticil, is distinguished by its position, and more obviously by its gay and pleasing colours. If the corolla be of one piece, or if the pieces be all more or less coherent, it is called *monopetalous* (gamopetalous; see index). (See Fig. 68.) When of several pieces it is *polypetalous* (Fig. 69). The individual pieces of which it is composed are called *petals*. See *a a a a a*, Fig. 69.

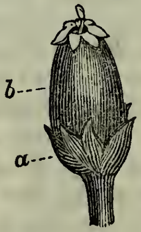


Fig. 68.—Monopetalous corolla; *a* the calyx; *b* the monopetalous, ovate, or urceolate corolla.

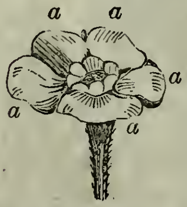


Fig. 69.—Polypetalous corolla.

The petal often, but not always, consists of two parts—the *claw* (unguis), and the *limb*. Such petals are common in the orders *Cruciferæ* and *Caryophyllaceæ* (see Fig. 70); *a* is the claw, *b* the fringed limb. Such petals are called *unguiculate* (clawed). Petals are generally uniform; the rounded, the obcordate, the ovate, and elliptic are the most common forms. Their limb is often notched, cleft, parted, and sometimes fringed. In monopetalous corollas the coherent portion is called the tube, and the free portion the limb, as is the case in the calyx. The monopetalous corolla is regular, when the limb or expanded portion is symmetrical, as in Campanula (Fig. 71). It is irregular in *Salvia* (see Fig. 65), *a* the calyx, *b* the corolla, and in the Foxglove (Fig. 72).

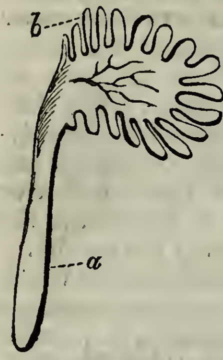


Fig. 70.

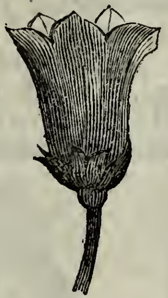


Fig. 71.

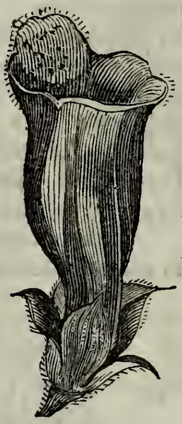


Fig. 72.

The polypetalous corolla is regular when the petals are equal, and are arranged symmetrically, as in the *Crowfoot*, the *Rose*, the *Wall-flower*, and the *Evening Primrose*, &c. (Fig. 69), is a regular polypetalous corolla. It is irregular when the petals are unequal, or when the arrangement is not symmetrical. The *Sweet Pea* is an example of the latter. In this flower the petals are unequal, and their arrangement is unsymmetrical (see Fig. 73). This form is called the *papilionaceous*, and, like most polypetalous corollas, consists of five petals; the upper is called the *vexillum*, or standard; the two lateral the *wings;* and the two inferior the *keel;* these latter are partially or entirely covered by the wings, and often slightly united. All the leguminiferous plants of Britain are of this form.

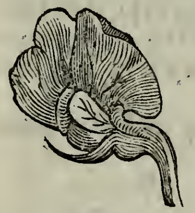


Fig. 73.

The accessaries or appendages of the petals, are chiefly the nectaries (honey-pores at the base of the limb), in many ranunculaceous plants; and the crown or scales at the base of the limb, or at the top of the claw, in several of the plants composing the Pink family.

28. *Stamens.*—These organs are essential, and their use is to give vitality to the seed. They are composed usually of two parts, the filament and the anther (see Figs. 74, 75).

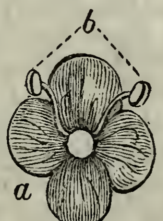


Fig. 74.—*a* the corolla; *b* the stamens.

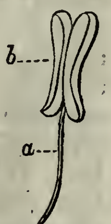


Fig. 75.—*a* the filament; *b* the anther.

Stamens are distinguished by their number, by being free or adherent, and by their position. When their number is equal to, or double the number of the petals, they are said to be *definite*. When their number is greater than twice or thrice as many as the petals, they are *indefinite*. They are said to be *free* when not attached to each other, although they are virtually attached when they spring from the inner side of the tube of a monopetalous corolla, and they are also attached by the calyx when they grow on it; but in both these latter cases they are considered free. They are united when attached to each other at the base only, or by a sort of web-like development, which extends nearly to their upper extremities. The former is the case in *Hypericaceæ;* the latter in *Malvaceæ*, *Geraniaceæ*, and *Leguminiferæ.* When they are all united, as in the mallow, they are said to be *monadelphous ;* when they form two or several parcels, they are said to be *diadelphous* or *polydelphous.* In determining the classes, orders, &c., of plants, the position of the stamens is of more importance than their number or their connexion. Their position is twofold—first, in relation to the ovary; and second, in relation to the petals or lobes of the corolla.

When situated (placed) on the *torus* (disk of the peduncle, on which is seated the organs of fructification), the insertion of the stamens is *hypogynous*, *i.e.* under the ovary (see Fig. 76.); *a* part of the peduncle; *b* the disk or torus; *c* the stamens; *d* the anthers; *o* the ovary. When they are inserted on the calyx they are said to be *perigynous* (round about the ovary) (see Fig. 77); *a* the calyx; *b* the stamens; *c* the ovary with its carpels.

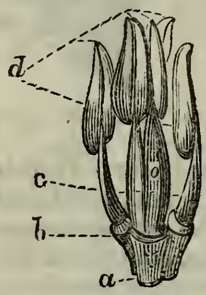


Fig. 76.

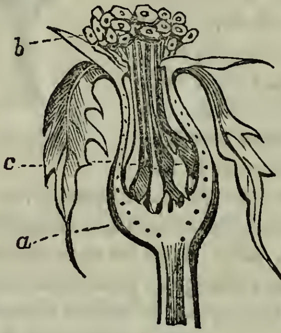


Fig. 77.

When the stamens are placed on the ovary, along with the outer floral envelopes, their insertion is *epigynous* (upon the ovary), (Fig. 78); *a* ovary; *b* calyx; *c* corolla; *d* stamens and anthers; *e* style and stigma. In relation to the other parts of the flower the stamens are usually placed alternately with the petals, only slightly above them, just as the petals alternate with the sepals, and are slightly above the latter. When the stamens are opposite to the lobes or petals, a row or series of stamens is supposed to be wanting. When the stamens occupy more rows than one, they alternate with each other. Sometimes one of the rows is abortive, as in *Parnassia* and other plants.

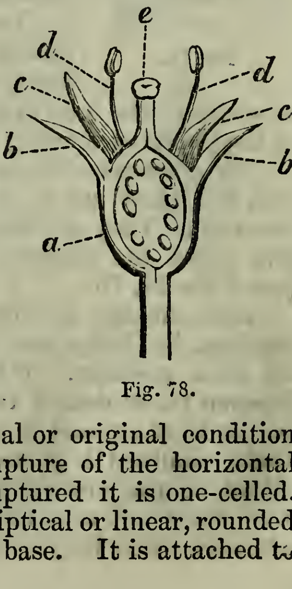


Fig. 78.

29. *The Anther.*—This organ, in its normal or original condition (four-celled), is usually two-celled by the rupture of the horizontal partition. When the vertical partition is ruptured it is one-celled. Its form is various, but usually more or less elliptical or linear, rounded or cordate, often forked at the apex or at the base. It is attached to

the filament either at the base (by basal attachment) (Fig. 79); *a* filament; *b* anther; *c* connective; or it is attached by its base and through its whole extent (Fig. 80). It may be attached by its centre (versatile attachment), (see Fig. 81); *a*, anthers; *b* filaments. When attached by its apex, the anther is pendulous (Fig. 82); *a*, anther; *b*, filament. Fig. 83 represents the pendulous anther of *Pyrola rotundifolia* opening at the top by pores; *a* anther; *b* pore. The anthers discharge the pollen or fertilizing substance by slits, pores, holes, &c.

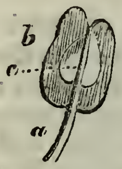


Fig. 79.

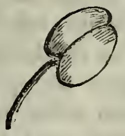


Fig. 80.

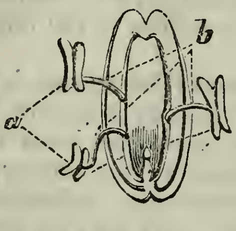


Fig. 81.

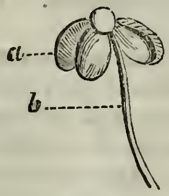


Fig. 82.

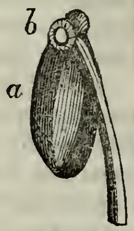
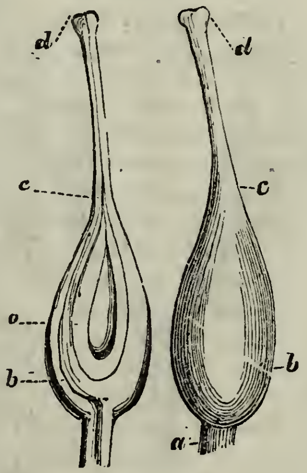


Fig. 83.

30. *The Pollen*, or powdery matter contained in the anther-cells, consists of series of very minute cells contained in each other. The ultimate cell or parent utricle is resolved by division into four parts, each of which forms a granule of pollen. In some plants, *Orchids* for example, the pollen-grains are united into masses by viscid matter; but in general the grains form a powdery substance of exceeding minuteness.

31. *The Pistil.*—This organ occupies the centre of the flower terminating the axis, it being surrounded by the stamens and outer or lower floral envelopes when they are developed. It is the innermost whorl, and is generally considered the female organ of the plant, as the stamens are the male parts, and its destination is to produce fruit or seed. The lower part, when fully developed, becomes the fruit. The Pistil is divided into three parts, the *ovary*, the *style*, and the *stigma*. In the annexed cut (Figs. 84, 85) *a* is the peduncle or carpophore; *b* the *ovary*; *c* the *style*; and *d* the *stigma*. In Fig. 84 the pistil is divided longitudinally, in order to show the pendulous ovule *o*, suspended by its funiculus *b*; *c* the connecting channel or style between the stigma *d*, and the ovule *o*.

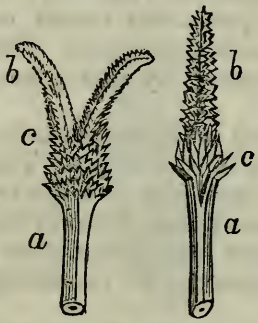


Figs. 84, 85.

32. *The Ovary* or germen is composed of a modified leaf, or of several modified leaflets, the mid-rib or mid-ribs forming the style or styles. Hence the ovary is either *simple* or *compound*; it is simple if formed of one leaflet, and it is compound when formed

of several. When the ovary is simple it is *one-celled* (unilocular), and when compound it contains *several cells* (pluri- or multilocular). The style is modified by the nature of the ovary. It is simple or single when the ovary is one-celled, and compound when the ovary is pluri- or multilocular. The styles, in the latter case, may be combined or distinct.

33. *The Style* when present (the stigma is sometimes sessile) is usually cylindrical, and traversed by a narrow canal, which is partly filled with elongated cells or tubes, that form the conducting tissue; so called because it is the medium for conveying the pollen-grains to the ovary. The modified leaflet or leaflets are called *carpels*, and each carpel is usually provided with its own ovary and style. The union of several carpels constitutes a compound pistil. When the style is single, either from originating in a single carpel, or from originating in the combination of several styles of united carpels, it is termed *monogynous*. When the styles are two, they are *digynous*, &c.; when numerous or indefinite, *polygynous*.



Figs. 86, 87.
a the style; *b* the stigma; *c* the calyx.

34. *The Stigma* is the continuation or termination of the style. It contains also the orifice whereby the pollen-grains enter the style, and by which they are conveyed downward to fertilize the ovules in the ovary. Its structure is lax and cellular, and frequently provided with projections or hairs, which collect and retain the pollen-grains that are shed upon it from the anthers (see Figs. 86, 87). The stigma may be simply cleft, as Fig. 88; *a* style; *c* cleft-stigma; 3-cleft, as in *Polemonium;* 4-cleft in *Campanula*. The style is sometimes prolonged beyond the stigma, and the projecting part is furnished with collecting hairs (Fig. 89). *a* style; *s* stigma; *p p* parts of the style projecting beyond the stigma, and furnished with collecting hairs.

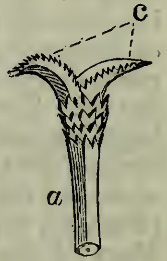


Fig. 88.

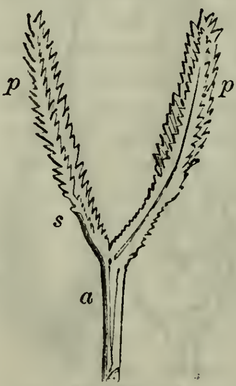


Fig. 89.

When no style intervenes between the ovary and stigma, the latter is sessile. This kind of stigma is found in some plants of the Poppy-family, and in several of the *Cruciferæ*, &c.

35. *Carpology* treats of the mature pistil, or the nature and various modifications of the fruit, including the *ovule*, the *funiculus*, or *umbilical cord*, the *placentation*, and the forms and divisions of the ovary, on which depend the form and nature of the fruit.

36. The *Ovule* is destined to become the future seed after it has

been fertilized by the pollen. Fig. 90 is a representation of the mature pistil or the ovary advanced to maturity. *a*, the capsule; *b*, the seeds, originally ovules; *c*, the persistent style; *d*, the stigma. The ovules are always contained in ovaries, except in *Coniferæ*, for they do not receive the pollen immediately, but by the intervention of the style and stigma. Direct impregnation only takes place in the orders *Coniferæ* and *Cycadaceæ*.

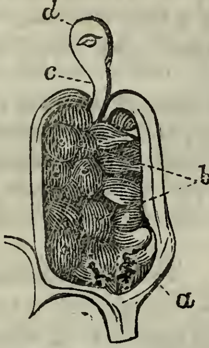


Fig. 90.—Vertical section of Viola odorata, with the ovules on the parietal placenta.

There are some plants where the ovules are partly exposed, as *Reseda;* but they have an open-mouthed ovary, and are attached to a placenta.

The *Placenta* is the more or less extended cellular medium on which the ovules receive nourishment; they are sometimes sessile, and sometimes attached to the placenta by a *funiculus* (little cord, or podosperm). The placenta or trophosperm is usually at the junction of the carpellary leaflets (see Figs. 91, 92).

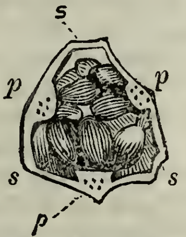


Fig. 91.—Horizontal section of the above, showing the placentation, *p p p*, and the sutures, *s s s*.

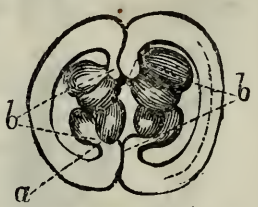


Fig. 92.—Erythræa Cent: *a*, carpellary leaflet; *b b*, edges on which the placenta is formed.

At the junction of the margins of the carpellary leaflets there is a development of cellular tissue, which constitutes the placenta. This junction of the edges to which the ovules are attached is termed the ventral suture, and the midrib of the carpellary leaflet is the dorsal suture. These two terms, ventral and dorsal sutures, and ventral and dorsal dehiscence, or opening, are of the highest importance in carpology. The nucleus of the ovule is a series of very minute cells, with a cavity towards its upper extremity, which cavity is destined to receive the pollinary grain, and hence is called the embryo sac. At the apex there is an aperture through all the integuments. *primine*, *secundine*, *tercine*, &c., however many or few there be, This opening is called the *foramen*. The nucleus and its integuments, as above named, are united at the base of the ovule by a membrane called the *chalaza*. The point of junction of the ovule with the placenta is the *hilum*. This part is much developed in seeds of the *Leguminiferæ*, and in the Horse-chesnut. When the *hilum* (junction of the ovule with the placenta) and the *chalaza* (junction of the nucleus of the ovule and its coats), and the *foramen* (the hole through which the ovule is fertilized), are all in the same plane, or if a straight line will join all three, the ovule is *orthotropal*. This is the normal state of the ovule, or its position at first. It retains this position in some orders, as *Polygonaceæ.* When the ovule is so curved on itself as that the foramen approaches the hilum, it is *campylotropal.* When the hilum occupies the place of the foramen, the ovule is *anatropal,* inverted; in this case the foramen points downwards, opposite to the chalaza, but contiguous to the hilum. The position of the ovule in the ovary is various. When the ovary contains only a single ovule, which is attached to the base, the *placentation* is *basal,* and the ovule is erect (orthotropal). When inserted above the base on a parietal placenta, and when the apex of the ovule is erect, it is termed an *ascending ovule;* when the placentation is parietal, and the apex of the ovule is directed towards the base of the ovary, the ovule is termed *descending.*

There are many other positions of the ovule. These are caused or modified by the length of the umbilical cord, the situations of the placentas, &c. When several ovules are in one cell, they affect the position of each other, change their form, and often produce abortions. For further details of the ovules and their position, consult Carpenter's "Vegetable Physiology," also the Index to this work.

37. *The ovary,* as already stated, is formed by the union of the margins of one or several carpellary leaflets, thus forming a carpel or several carpels, and the fruit is consequently composed of one carpel or of several. The union of the carpels is often so slight that they separate even before the fruit is ripe. This is the case in the Spurge, where the carpels are connected laterally. When the carpels are distinct, as in Ranunculus, the fruit is termed *apocarpous.* (See Fig. 93.) *a,* the aggregate but distinct carpels; *b,* a single carpel magnified.

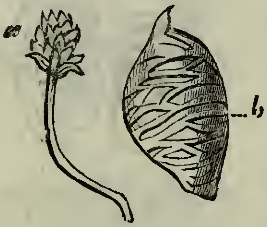


Fig. 93.

Syncarpous fruits consist of several carpels, as Apple, Bellflower, &c. The seed vessel, or ripened ovary, is either fleshy, as Apple, Cherry, &c.; or juicy, as the currant; or more or less herbaceous, membranous, or scarious, as the *Pea, Stock, Pink, Pimpernel, &c.;* in the latter cases, it is usually called a capsule. It consists of the *endocarp,* or internal lining; the *mesocarp,* usually more or less cellular, very much developed in the *pomaceous* fruits, and the *epicarp,* or the external pellicle (epidermis). These different parts of the pericarp are only evidently developed in fruits which are more or less fleshy, as Pear, Sweet pea, and such like. The *pericarp* is either one-celled or many-celled. The 1-celled pericarp is formed by the junction of the opposite edges of one carpellary leaflet; the 2-, 3-, 4-, or more-celled pericarp, by the junction of 2, 3, 4, or several leaflets. If there be two carpellary leaflets, with their margins meeting in the centre, the pericarp is 2-celled; if 3 carpellary leaflets form the pericarp, or ovary, the pericarp is 3-celled, and so on. The partitions thus produced are called dissepiments. When the carpels unite regularly in the centre, each carpel becomes a distinct cell; but the distinctness of cells frequently disappears, owing to the rupture of the dissepiments. And a central placentation and one-celled pericarp are not unfrequent where the normal number of cells is five, but where the partitions disappear during the progress of the pericarp to maturity. In *Caryophyllaceæ*, the placentation is not produced on the accrescent margins of the carpellary leaflets, but on a prolongation of the central axis of the flower. This placentation is found also in *Primulaceæ, Santalaceæ*, &c. Marginal or carpellary placentation, however, is the rule, and central or axile the exception.

38. *Dehiscence and nondehiscence* (opening and not opening) of pericarps. *Dehiscent* pericarps are of several kinds.

1st. Such as open by the ventral suture only—as *Columbine, Marsh Marigold*, &c.

2nd. By both ventral and dorsal sutures—as *Pea*, &c.

3rd. By two valves united when entire by a sort of frame (replum). This form of pericarp is usually termed a silique, or pod, and opens from the base upwards, (Fig. 94.) *a*, valves; *b*, frame; *e*, seeds. The silicule, or pouch, is a shortened or modified form of the silique. (See Fig. 95.)

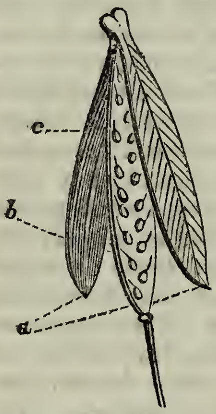


Fig. 94.

4th. Opening by a lid—*Pimpernel.*

5th. By valves, slits, or pores—*Bellflower, Snapdragon, Poppy*, &c.

6th. Opening by separation of carpels—*Spurge.*

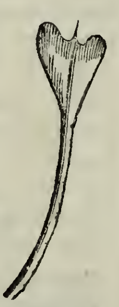


Fig. 95.

Indehiscent pericarps contain one seed, or more than one, and are either fleshy or dry. Apple, Medlar, Gooseberry, are examples of these pericarps. The Cherry, Acorn, also the fruit of Maple, Goosefoot, Dandelion, Grass, &c., illustrate these indehiscent, one-seeded pericarps. In some of these the seed is loose; in others, it is closely invested by the pericarp.

39. *The Seed* consists of the seminal coats (formed of or by the union of the primine, secundine, &c., of the ovule), and the embryo, which is usually accompanied with the *albumen* (perisperm), a mass of cellular tissue, sometimes mealy, as in Wheat, Rye, and other cereals; and sometimes fleshy, as Cocoa-nut. Sometimes the embryo contains all the albumen of the seed, as in Pea and other Leguminiferous plants.

40. *The Embryo* consists of rudimentary leaves, a rudimentary stem and rootlet, or radicle. The first of these is called the *cotyledons*, the second the *plumule*, and the third the *radicle*. The reproductive bodies of cryptogams have no cotyledons, nor plumule, nor radicle; hence these plants are called *acotyledonous*. The next grand division of plants, Endogens, bear perfect seeds, which have one cotyledon, or seed-leaf, or alternate cotyledons; hence these are termed *monocotyledonous* plants.

Exogens produce seeds which germinate with two cotyledons; hence these plants are called *dicotyledonous* plants. (Fig. 96.)

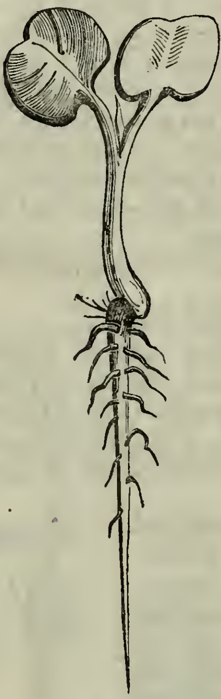


Fig. 96.

41. *Application of the floral organs to the determination of divisions, classes, orders, and genera.* All plants may be arranged under one or other of the two primary grand divisions of *flowerless* and *flowering* plants (cryptogamous plants, *plantæ cryptogamæ*, and phanerogamous plants, *plantæ phanerogamæ*). The former grand division is characterised by the *absence* of floral envelopes; they want stamens and pistils, and their reproductive bodies are different from true seeds in structure. The lower orders of flowerless plants have a centre of vegetation, and increase in all directions round it; the higher orders of the same grand division have stems only in the highest orders, and these stems or fronds (leaves) rather increase by additions to their apex, than to both diameter and apex, as is the case in the flowering orders. Again, there is nothing in the flowerless orders analogous to stamens and pistils, and they have scarcely anything analogous to sepals and petals. Their spores or reproductive bodies are capable of reproducing individuals like those on which they were themselves produced; but here their analogy with true seeds ceases. Their organization is not even so complicated as is that of buds; they differ but slightly from the plant on which they grow. They are without cotyledons, plumule, and radicle, albumen and integuments. The whole spore is equally capable of germination, and consequently germination may take place at any part of it. They are acotyledonous, because their reproductive bodies (spores) are of uniform structure and consistence.

It has been already stated, that the flowering plants are subdivided into two sub-divisions by the structure and position of their vegetative organs; it now can be shown that these grand divisions are characterised by their seeds and by their floral envelopes. The seed of an endogenous plant (first sub-division) has its embryo concealed in a sheath at the period of germination; it also germinates with one cotyledon (seed-leaf), or with alternate cotyledons, not with opposite cotyledons, as is the case in exogenous plants. In the former, Endogens, the floral envelope is mostly single, and the floral and fruit-organs are mostly three, or a multiple of three, except in cases of suppression, when one third or two thirds are to be subtracted, or in cases of redundancy, where one-third or two-thirds are to be added to the normal numbers, three, six, nine, &c. The second sub-division is also characterised by all these marks, which differ from the distinctive characters of Monocotyledons. The seed germinates with two lobes: hence the term Dicotyledons. The floral envelopes are usually double, and the number of organs in the flower, &c., is five, or a multiple of five, or a suppression of one-fifth, or two-fifths, or an addition of one-fifth, or two-fifths, &c. For example, the normal number of sepals, petals, stamens, carpellary leaflets, is five, or twice five, or five with one-fifth, or two-fifths subtracted, or with one-fifth or two-fifths added.

42. *Relation of the Ovary to the Calyx.*—In distinguishing classes or secondary sub-divisions, the relation of the ovary to the calyx affords very important characters. First, the ovary may be quite free, or it may be attached or adherent to the calyx. This mark separates the orders *Hydrocharidaceæ*, *Orchidaceæ*, *Amaryllidaceæ*, *Iridaceæ*, and *Dioscoreaceæ*, from all the other monocotyledonous orders. In the dicotyledonous orders it serves to distinguish some of the apetalous and monochlamydeous orders, from other orders which are without a perianth, or have only a single perianth. It is of equal importance in subdividing the polypetalous and monopetalous orders. The insertion of the stamens is of similar importance. Many orders are characterised by having the stamens situated under the ovary (hypogynous insertion). The *perigynous* stamens (stamens produced on the calyx) characterise another large group. When the ovary is adherent, the stamens are always *epigynous;* and when the stamens are *hypogynous*, the ovary is always free. A few orders—viz., *Fumariaceæ*, *Malvaceæ*, *Geraniaceæ*, *Hypericaceæ*, and *Leguminiferæ*, are distinguished by the union of the stamens in one, two, or three parcels. The stigma is cleft and feathery in *Gramineæ*, cleft in *Compositæ*, 4-cleft in *Campanulaceæ*, sessile in *Papaveraceæ*, and very short or sessile in *Cruciferæ*. The corolla is not a very constant organ; it is absent in certain genera and species of some very extensive orders—for example, *Ranunculaceæ* and *Cruciferæ*, rarely in *Caryophyllaceæ ;* also, in *Rosaceæ*, *Saxifragaceæ*, *Primulaceæ*. The irregular labiate corolla is characteristic of most of the order *Labiatæ ;* and there is usually more or less irregularity in the corollas of *Scrophulariaceæ* and *Lentibulaceæ*. All the British examples of *Leguminiferæ* have irregular papilionaceous corollas; and several genera of *Ranunculaceæ*, and the orders *Fumariaceæ* and *Polygalaceæ*, have the corolla irregular. The persistency or caducity of the calyx is a very constant character. It is caducous (speedily falls off) in most genera of *Ranunculaceæ*, in *Papaveraceæ*, and *Cruciferæ*. It is persistent in *Cistaceæ*, *Violaceæ*, *Caryophyllaceæ*, *Geraniaceæ*, *Malvaceæ*, *Hypericaceæ*, *Leguminiferæ*, *Rosaceæ*, and in all monopetalous orders. It is rudimentary, or reduced to a mere rim, in *Valerianaceæ*, *Umbelliferæ*, and *Compositæ*. A few orders are distinguished by their mode of inflorescence—for example, *Araceæ* and *Typhaceæ* by their spicate inflorescence; *Dipsaceæ* by their capitate flowers ; *Compositæ* by their compound flowers on a common receptacle; *Umbelliferæ* by their umbellate flowers.

PHYSIOLOGY.

FLOWERING AND DURATION OF PLANTS.

Vitality—General or Abstract idea of Life.—By life is meant the entire series of the activities of all the organs which exist in animals and plants, with their resulting phenomena. Vital power is the distinctive quality or peculiarity of appropriating simple chemical substances, and of applying them to the production of other substances, such as cannot be produced by any mere mechanical power, nor by any human process whatsoever. The primary development of the simple cell, whether animal or vegetable, is the primary manifestation of the presence of vital power and vital action. This primary cell is formed by the absorption and assimilation of new matter; and by the continuous absorption of nutritive matter from without, this primary vesicle is capable of increase; *i.e.* it has the power of growth. All bodies thus produced by vital agency are limited both in space and duration. A crystal which increases mechanically by successive deposits may go on enlarging itself as long as the material capable of crystallisation is supplied. There is no limit to its extent, nor to its duration: it is limited only by the supply of the fluid matter in which it is developed. When a plant or an animal, on the other hand, has reached in magnitude and duration, to a certain extent, the vital action or power of increase ceases, and the body previously endued with vitality or animation begins to decay, and is decomposed into a new series of chemical combinations. The periods assigned for the duration of living beings is very unequal, some existing only a few hours; some, as trees, prolonging their existence for hundreds, and some for thousands of years. The power of life is limited to the assimilation of materials from which it produces organic forms: it has no creative power. None of the substances found in plants are produced in them; they are all derived from without, and by the power of vitality caused to assume certain new forms and combinations. There are some obvious, prominent laws which regulate the formation of inorganised and organised bodies. Crystals, for example, are developed with flat surfaces, and are bounded by straight lines, and with either right, or obtuse, or acute angles. Plants and animals have their surfaces bounded by round or rounded lines. The cylindrical or spherical form, or some of the almost infinite modifications of this form, are generally prevalent in both the vegetable and animal kingdom. Another characteristic feature of living bodies is derangement of vital functions, consequent decay, death, and finally dissolution. Inorganised matter is not subject to any similar periodic changes. Mechanical and chemical changes do take place in these, but they are not periodic, neither diurnal nor annual, but are as lasting as their causes. In organised objects there is a power which counteracts the continuous effects of chemical, mechanical, or other stimulating causes; and this power is called vitality.

Vegetable Physiology, or the doctrine of the life of the whole plant, and of its particular organs, treats of the general phenomena of vegetation, of the mechanism in a state of action, of the vital principles of both simple and compound organs of the vital stimulants to germination, of maturation, decay, and death, together with nutrition or the food of plants, their productive functions, and periodicity. The simple but exquisite organs of plants would be incapable of exercising their functions, if they were not endued with certain properties which are generally termed vital properties. These are elasticity, extensibility, and contractibility (irritability of some authors), and permeability, which render them susceptible of being acted on by vital stimulants. These qualities are eminently resident in the cellular tissue, and are manifested by the celerity wherewith injured parts of plants are healed, especially if the injury has been inflicted while the plant is in a condition of vigorous growth. In the lowest orders of vegetables—Fungi, for example—the plant may be cut in two parts; and if access of the air be prevented by bringing the sections into contact, they will speedily coalesce. Any plant may be lopped, pruned, or partly destroyed, still the portion attached to the ground lives, and under certain circumstances the lopped portions will produce new plants. The presence of vital activity in the cellular tissues is also proved by grafting. The graft or slip is always (in whatever way the operation may be performed) so placed that the bark of the slip may coincide with the bark of the stock. The slip is so inserted into the cleft of the stock as that the portions of bark on each side of the cleft may exactly correspond with the small portion of bark on the outer side of the slip. When this is nicely effected, and the admission of air prevented by compost and bandaging, the cohesion of the slip and stock is speedily effected; and this union commences in the cellular tissues of the bark. Slips are also rooted in sand, with or without artificial heat and shade, and the rootlets are protruded from the cellular tissue of the bark. The buds and seeds are also mostly cellular, covered by their epidermis or tunics (coats) respectively. But notwithstanding the intense nature of the vital power and the qualities of the tissues whereby the vital principle is capable of acting and of being acted on, there will be no vital action on the simple organs without the aid of what are called vital stimulants. These are heat, moisture, air, and light. Moisture is absolutely necessary to the germination of seeds, which will never grow, unless placed where there is somewhat more moisture than is contained in them. The tissue being extensible, expands or elongates, and thus the cell or cells acquire more space, and are consequently capable of imbibing more moisture, and also of allowing the viscid matter wherewith the cell is lined to expand, and so fill up the vacuum caused by the extension of the cell-walls. The effect of heat on the cell and its contents is an expansion, both of the external walls, the internal linings, and the fluid granular matter which the cell contains. The extensibility of the cell is thus alternately in a state of action and reaction; for when the temperature from any cause whatever is lowered, the contractible quality of the cell is exerted, and forces the fluid contents, which are not compressible, through the cell walls, which are permeable, into other contiguous cells. By means of the two stimulants, moisture and heat, acting upon the elastic wall of the cell, producing regular expansions and contractions of its dimensions, the sap of the cells is forced through the walls, either filling up, or forming new cells. It has been already stated that the cells are the primary formations; and in the infancy of every plant the central cellular tissue or pith performs a very important part in the development of the future individual. The rootlets, which are only a continuation of the plumule (primary or elementary stem) suck up moisture (water) with whatever else may be held by it in solution; and this in the first instance is merely the chemical constituents of the seed, or such of them as are capable of solution in water. With this sap new cells are produced by the formative power of the plant, new matter is derived from the soil or atmosphere, and enlargement and development are the results.

At this early period the medullary rays play a very active part both in forming compartments wherein the vascular bundles or woody tissues are subsequently produced, as well as in laying the foundation of the future bark. At this early stage of development the vital energy is confined to the centre, or is resident in the pith; until the stem is formed, or in the course of formation, the vital action is limited to the central part, which subsequently, when the sap can be conveyed by other means, decays or disappears. Subsequently the inner bark and the external and recently-formed woody layers are the principal means of conveying nutriment to all parts of the plant, or the medium of inter-communion between the root and the leaves. During the extension of the stem in an erect or upward direction, the root is extending itself in an opposite quarter, developing branches and fibrils. Each of the latter ends in a very cellular substance called the *spongiole* or spongelet, which imbibes water and its contents from the surrounding soil. It is as yet undecided whether this apparatus which imbibes, and is the only part of the root capable of imbibition, be like the suctorial apparatus of animals, which latter acts by withdrawing the air from the lungs, and thus producing a vacuum, the fluid in contact with the sucking medium naturally flowing onwards to restore the equilibrium; or whether the act of sucking in the plant be not mechanical or capillary, like the absorbency of sponges, candle-wicks, &c.

It is ascertained that the fluid nourishment of the plant enters by the very ends of the rootlets, and that it is conveyed primarily by the pith or central part of the vegetable, and subsequently by other channels, and chiefly through those of the bark and cambium into all parts of the plant which are in a state of growth. In trees, after the lapse of a very few years, the pith becomes dry, and consequently transmits the sap no longer. In old trees it is contracted, as the woody, contiguous parts are compressed by the external layers, and finally the medullary sheath is entirely filled up with wood, and the pith consequently disappears. The central wood, if not dead, is quite incapable of transmitting fluids. The ascent of the sap and air (circulation as it used to be termed) is accomplished by means of the recently-formed bark and wood. In old hollow trees we have a proof that the centre of the tree is not necessary to its remaining in vigorous growth. Some of the oldest Yews have existed probably thousands of years, and during a large portion of this long period have been reduced to a few inches of wood surrounding and partly inclosing the space which the wood of the tree at some remote period entirely filled. These trees are as healthy externally, and the process of vegetation goes on as steadily, as if the tree were only a few hundred years of age. The sap flows on in its thin rind,—for it is little more than a bark-like rind or shell,—and the top shows no symptom of decay; even the topmost twig is invigorated by the sap, and performs its functions in the economy of the tree. It is not improbable that the death or decay of the central parts of trees does really promote their healthy and prolonged existence, for the sap will flow more readily, and yield more nutriment when it is confined within narrower limits than the extent of the whole diameter of the trunk. It is not improbable that the longevity of the Oak, and other trees of long duration, is owing to the hardening of the central wood, *duramen;* so that this centre is no longer capable of taking any part in the vital processes of the tree. The Yew certainly corroborates this view; for it is by far the most durable of living beings, except perhaps the Monkey-bread-tree of Central and Southern Africa; having in many instances existed since the very beginning of the creation, and being so often found reduced to a mere shell or part of a shell, yet without manifesting the slightest symptoms of decay in its uppermost twigs, where the decay of all trees first discovers itself. In suitable soil, if preserved from atmospheric influences, such as storms and casualties, fires, and other mechanical injuries, Yew-trees would be almost, if not quite perennial, and endure as long as the chalky hills and combs in which they delight to grow. As collateral support of the same view, it may be stated as a well-known fact, that trees of rapid growth and little density speedily decay; as, for example, Poplars, Willows, Mountain ash, &c. Even the centre in these trees is never so dense as to prevent the passage of liquid or gaseous matters; *duramen,* or hard wood, is never formed in them, and the presence of sap, in every part, contributes doubtless to the speedy decay of these soft-wooded and fast-growing trees.

Circulation of Sap.—Little is with certainty known about the circulation of sap. It is known that the circulation in plants, as it is called, is totally dissimilar to the circulation of the blood in animals. There can be no real circulation in plants; for the fluid enters by the root or lower end, and passes off by the leaves; the upper extremities leaving behind only the condensed or solid materials, which have been, by the vital power of the plant, extracted from the water, and either assimilated to and made part of the plant's substance; or secreted and laid up in peculiar reservoirs for other subsequent operations. There is a greater similarity between the conducting tissues in plants, and the alimentary canal in animals, than there is between the circulating fluid (blood) of the latter, and the ascent and distribution of sap in vegetables. But analogies between bodies so differently constituted have more of fancy than of reality in their origin. Every part of an animal is endued with vitality. In plants (trees), the larger portion of their interior may be dead or absent, and the remaining external parts perform all the functions of an entirely perfect being. No animal can exist under such circumstances. The grand channels for the circulation of animal fluids is near the centre of their bodies. In plants the sap is conveyed at or near the exterior parts of their substance. In plants the organs of exhalation are simple and external; the corresponding organs of respiration in animals are of a more complex character, and are internal. Plants are far more tenacious of life than animals are, and are generally of much longer duration, and can bear greater alternations of temperature. Sap is certainly conveyed by the cellular tissues so long as they are in a vital condition; and hence cellular tissues in a state of vital action must be present in some part or other of every living plant. The cells secrete as well as convey. It is supposed that the spirals (tracheæ) convey air as the cells convey sap, and hence the name tracheæ (wind-pipe). But doubtless every tissue, whether spiral or vasiform, contains something, either air or sap, or some air and some sap. It is certain that nature abhors a vacuum; and every vessel, whether cellular or vascular, if it be in a living condition, must be filled with something, and that something must be fluid, either aqueous or gaseous; for it is universally admitted that the plant cannot imbibe nutriment except in this form. Hence there is another distinction between the two kingdoms of organized beings, derived from the nature of their nourishing *media* respectively. Animals feed on organized matter, and are capable of receiving it into their bodies either in a solid or fluid condition. Plants are supported on inorganised matter solely, and they imbibe this matter in a fluid condition, either in an aërial or liquid state.

Nutrition of Plants.—It has been already stated that the plant is composed of certain proportions of cellular tissue, vascular tissue, and woody fibres, and that while in a living state all these tissues are filled with fluids of an aqueous or gaseous nature. An analysis of the contents of the cells, &c., will show that the plant contains some solid substances, such as starch, leaf-green, resins, &c., and partly a watery solution containing sugar, gum, acids, albumen, and in several plants essential oils. None of the chemical substances found in plants exist naturally in the soil from which plants derive their constituents. The earth yields no starch nor albumen, nor essential oil, nor gum, nor sugar. It does not even contain, in an uncombined condition, any carbon, or hydrogen, or any oxygen or nitrogen, or any sulphur or sulphates. Yet it is by a combination of two or more of these simple substances that the organic constituents of all plants are formed. Before any substance can be absorbed by the spongelets, and hence enter into the cellular and vascular tissues of the plant, such substance must exist in a liquid or gaseous form. Carbon, one of the primary constituents of all plants, is insoluble in water; but it exists abundantly in a gaseous state as carbonic acid gas; and in this condition it is absorbable by plants, and chiefly by the roots or sponglets. The decomposition of vegetables, or of vegetable substances, supply carbon in this state to the soil and to the growing plants. Oxygen and hydrogen are absorbed through the medium of water, of which these are the two chief chemical constituents. The nitrogen in combination with hydrogen forms ammonia, and in this gaseous state it is absorbed by the roots of plants. Sulphur, which exists in a smaller proportion in plants than any of the above mentioned constituents, is absorbed in combination with oxygen in the form of sulphuric acid.

These nutritious media, as above stated, produce, by assimilation and elimination, the numerous chemical substances found in plants; for example, carbon, hydrogen, oxygen, nitrogen, and sulphur, combined in certain definite proportions, form *albumen*, *fibrine*, and *caseine*. Carbon, hydrogen, oxygen and nitrogen, in certain specific combinations, form what is termed the *organic bases*. Carbon, hydrogen, and oxygen, form *vegetable acids*, *woody fibre*, *starch*, *gum*, *mucilage*, *sugar*, *fats*, *leaf or sap-green*, *resin*, *colouring substances*. Carbon and hydrogen form *volatile oils*. The above-named materials, obtainable from plants by chemical analyses, are all combustible. The under-mentioned are the results of combustion, viz.—*carbonic acid*, *silicic acid* (silica), *phosphoric acid*, *sulphuric acid*, *nitric acid;* also the following metallic oxides—*soda*, *potassa*, *lime*, *magnesia*, *oxide of iron*, &c., &c. All these are incombustible. It may be easily inferred from experience, that all plants do not contain the same constituents in equal proportions; but a certain amount is necessarily present in every plant. Every order, genus, or species of plants, has a distinct and individual power of assimilating such portions or proportions of the nourishing materials supplied to it, and of eliminating or rejecting the rest. Thus in the *Labiatæ* we find much essential or volatile oil, in the *Coniferæ* resinous matters, in the *Leguminiferæ* sulphur and gum, in the *Gramineæ* starch and silica. This property is called *assimilation*. Carbon, as has been shown, cannot be absorbed either in a solid or liquid form, consequently it is only absorbable when it forms the compound, carbonic acid (carbon and oxgyen). Although it is one of the chief nutritious constituents of plants, it cannot enter into the composition of cells, &c., till it has been set free from the presence of oxygen, and thereby acquires a capacity to assume a solid consistence. This property of freeing from other materials, condensation, &c., is termed assimilation, and is occasioned by an effect of one of the other active stimulants, viz., light. When the external parts of plants, viz., the young shoots and leaves, are exposed to this stimulus, they become green, and the surrounding atmosphere rapidly absorbs the oxygen, while the carbon remains fixed, or solidified; this is called the fixation of carbon. Hydrogen is absorbed in water, a combination of hydrogen with oxygen. In this case part of the water only is exhaled, and part of it is assimilated, or enters into the composition of the plant, from which it becomes inseparable, except by the destruction of the vegetable tissues. Nitrogen is combined with hydrogen, and forms ammonia in the soil, and in this compound state it enters into combination with the plants growing in that soil, though in a smaller proportion than the above-described nutritious media. Sulphur enters the plant as sulphuric acid, and when freed from the acid is the principal constituent in albumen, fibrine, and caseine.

The minerals, or incombustible constituents of plants, are combinations of alkalis and alkaline earths, as soda, potassa, lime, &c., with acids. These constitute but a small proportion of the weight of plants. They are all received into the plant through the medium of its roots. The proportions in which they occur are very various; for example, the stems of certain plants, as Wheat and other cereals and Grasses, also the stems of *Equiseta* (Horse-tail), contain much silica. Pea-haulm contains much lime; wheat-straw very little, but wheat-grains very much in proportion to their other constituents.

5. *Functions of the Compound Organs.*—It has been shown that plants absorb their aliment chiefly from the soil; they are supposed also to derive a portion of it from the atmosphere. There certainly exists in the leaves a medium of communication between the external air and the internal, or simple organs of plants, and there is no question about the respiration and exhalation of plants, as carried on through the stomata. But it is not so certain that plants, by their leaves or other green parts, inhale atmospheric air, or any air. They appear to inhale dew; for welted or partially shrunken plants speedily revive and become plump when exposed to moderate rain or heavy dew. The property of the root is to absorb nutriment from the earth; the property of the stem is to communicate part of this nutriment to the leaves, part being retained for its own growth. The leaves supply the means of carrying off the superfluous air and water from the sap; or they are the media of respiration and exhalation. It is not supposed that leaves are in any respect analogous to the pulmonary apparatus in animals. Air may escape from plants through any portion of their surface, either from the stem or leaves; and of course it may also obtain ingress from the atmosphere through the same channels. Air will always, through some means or other, be of the same density or specific gravity at equal distances from the earth's surface. If the internal air (that which appears to be pent up in plants) is through compression of the cell-walls, or tissues, rendered denser, it will force its way into either newly-formed cells, or into the atmosphere. If, on the other hand, the air in plants is more rarified (less dense) than the external air, the latter will, by ingress, restore the equilibrium. The tissues being elastic (extensible and contractible) will be subject to the alternations of temperature.

When the contents, as well as the walls of the cells, expand by an increase of heat, the tendency of the air will be to expand and to escape, either into recently-formed adjacent cells, or into the atmosphere; it will permeate the cell-wall more easily than it will enlarge it. When, on the contrary, the cells and their contents are contracted by a decrease of temperature, the air from without may enter to restore the equilibrium. It is probable, however, that the equilibrium, disturbed by rapid growth or distension of the cells, is restored from within rather than from without. It is usually stated, that the leaves inhale carbonic acid gas, and exhale oxygen gas. It is difficult to conceive that so simple an apparatus as leaves can perform an operation of such nicety as the inhalation of one portion (a very minute one, too,) of atmospheric air, and the rejection or non-inhalation of the rest (the greater part), with which the carbonic acid is so intimately blended. Even the respiratory organs of animals cannot eliminate the pure air from what is noxious. That the leaves exhale and inhale water there can be no reasonable doubt. But every green or recent portion of the plant performs this; otherwise leafless plants could not have this property. The solid materials of plants imbibed by the roots are dissolved in a quantity of water larger than the plant can assimilate; and this superfluous water is in all probability evaporated by the stomata on the under surface of the leaves, and also by the stomata which are in the bark of the green or recent parts of the plant. But as the tissues which contain the aqueous solutions are elastic, changes of temperature will affect the liquid in the same way in which the gaseous contents are affected; when the cells are compressed the sap will flow into other newly-formed cells, or reach the surface, whether green or not green, and be carried off into the atmosphere by evaporation. The oldest trees, if the vital functions be carried on at all, have most of the vital energy resident near the surface; and the old bark, when much fissured, as in old Elms, Oaks, and Firs, permits evaporation at these fissures; and where the bark is not in this state, but entire, as in the Beech, &c., it is very porous. The ascent and descent of the sap, if there be indeed any such periodic motions, is a subject of much obscurity. It is well known that at certain periods, as in the beginning of Spring and at the latter end of Summer, there is probably a greater absorption by the roots, and, consequently, a larger quantity of sap in the plant or tree. But the vessels that are in a state of activity or vitality are always full of sap or air. In Spring, or very early in Summer, when the buds and leaf-branches are developed, a larger measure of fluid materials is absorbed, in order to supply sap for the newly-formed vessels.

Periodicity.—In many, probably in all plants, there may be observed certain changes which are ascribed to the combined influence of light and temperature, or to one or other of these agents. What has been fancifully termed the sleep of plants appears to be owing to one or both of these causes. In the after part of the day Leguminiferous plants close their leaves,—that is, the leaflets approach each other, as if for mutual protection. This phenomenon is observable in the Trefoils, and in other trifoliate plants; the two lateral or basal leaflets approach face to face, and the terminal one is applied to the edges of the lower ones. Certain blossoms unfold their petals in the morning, and shut them up before noon, as the *Goat's-beard,* and some other compound flowers. Others, as the *Evening Primrose,* open their showy flowers about sun-setting. Some, as the *Poor Man's Weather-glass, Chickweed,* and many plants of the Caryophyllaceous order, expand their little blossoms when the atmosphere is dry; and in consequence a fine day is anticipated, when these plants open even to a cloudy or perhaps mizzling sky. These facts prove that certain species have idiosyncracies or characters peculiar to themselves. The decrease of heat acts upon the tissues of Trefoil, and of many other plants, and the effect of this action is as above stated, the converging of the leaves. The same causes accelerate the opening of the *Evening Primrose.* Some plants, as the *Dandelion,* open when the air is moist, as it usually is in the morning; the *Pimpernel* closes when moisture is present in the atmosphere. The same atmospheric causes produce contrary effects on different objects. Diurnal changes appear in some plants, which are always affected by the rotation of day and night. In other plants there may be a change, though it is not so manifest in the external organs as it is in those of the plants above-mentioned. But there are other and more important periodic changes in the condition of all plants. The duration of plants is very variable. Some species of annual plants, if the period of flowering be retarded, may endure two or more years. Some plants, usually deemed annuals, do not, under ordinary circumstances, require more than a few months to come to maturity, and ripen seed. Some of the *Chickweed* and *Speedwell* species ripen seeds in the space of six or eight weeks after the plants begin to germinate; so that the same plant may have (in the course of a spring, summer, and autumn) a progeny two or three times removed from the primary parent. In herbaceous perennial plants, or such as can prolong their existence for several years without the intervention of seeds, the whole vitality of the plant is lodged in the root, and the future herbaceous stem grows from a bud which was previously formed near the crown of the root. From this bud the stem of next year is developed.

The true distinction, between what are called annual plants or biennial plants and perennials, is, that the latter flower oftener than once from the same root. The former, whether they flower the first, the second, or the third year after the germination of their seeds, only flower once. The *American Aloe* only flowers once, though it lives many years before it is in a condition to shoot up a flower-stalk.

Duration of Flowers.—Some blossoms last only a few hours, as several of the *Poppies.* Some last a day, as the *Evening Primrose.* Some endure for weeks, especially in the spring, when the weather is usually cold and moist. The *Primrose* is in many seasons a flowering plant for three or four months. In gardens, the *Polyanthus*—a variety of the *Primrose*—generally accompanies the *Snowdrop,* the

Crocus, the *Daffodil*, the *Crown Imperial*, and all the early and late spring flowers.

Annual Periodic Changes.—The most important periodic changes of plants next to their germination, maturity, decay, and death, are the generally annual phenomena of leafing and flowering. Some of the lower orders of plants germinate, bear flowers, and die in short periods, and certain plants produce seeds in a few weeks; but the great bulk of plants only leaf and flower once a year, and are regulated partly by laws peculiar to themselves, and partly by the temperature, &c. All perennial plants, whether herbaceous or ligneous, have a period of cessation from growth. During this dormant state, the vitality of herbaceous plants is resident in the root or in the stem, if the plant be bulbous, like the *Onion*, or tuberous like the *Potato*. In the British and European forest and other trees, during at least six months in the year, there is no apparent growth; leaves, young branches, and shoots are not produced. Some trees are clothed with leaves at an earlier period of the spring or summer than others are—for example, the *Horse Chestnut*, though an exotic, is in full leaf at least ten days earlier than the *Oak*. The *Hawthorn* is in leaf before the *Blackthorn* is, though the latter blossoms two or three weeks earlier than the former. Several of the *Willows* exhibit their golden catkins long ere their leaves appear. Some of the same tribe bear both leaves and blossoms at the same time. The *Mezereon shrub* flowers in March; but its leaves do not appear for several weeks after the flowers. Most of our common fruit-trees expand their blossoms just before their leaves, as the *Pear* and *Apple*, or they unfold both leaves and flowers together, as the *Cherry*.

Some shrubs and trees retain the greater portion of their leaves longer than one year, and hence are called *Evergreens*. These latter produce new leaves every season, but only a portion of the then existing leaves fall off, and, consequently, they are always leafy. The permanence of leaves, either for a few months or for a few years, must be mainly owing to the state of the sap in the tree. We know that in most trees, when the sap is less abundant in the extremities of a tree, where leaves only are produced, the leaves begin to turn pale, or become of some hue very different from green, and subsequently fall off. Such trees are called deciduous, and this period of leaf-falling is termed *the fall of the leaf*. When the sap abounds in the leaf-stalk, and at the junction of the leaf and the stem or branch, the leaf is not easily detached. When, on the other hand, the sap is evaporated, or condensed, the leaf falls off by its own weight, or by the agitation of the tree. Deficiency of sap is the cause of the fall of the leaf. Is sap more abundant in Evergreens, or is the longer permanency of their leaves due to the structure of the leaf? Do Evergreens abound more in sap at all periods than deciduous trees? After an herbaceous plant has done flowering, and before its stem entirely decays, a bud is formed at its root, in which all the vitality of the plant resides during its dormant state. Before the leaves begin to decay, and some considerable time before they fall off, buds are formed in their axils (angles which they make with the stem or branch), and these buds remain unexpanded, but in a vital state, till next season. Though provision is thus made, both in roots and leaf-buds, in both herbaceous and ligneous plants, for the continuation of the growth or of the existence of the species, neither can be accomplished without some increase of temperature. This is shown by the fact that the Oak, which in early seasons expands its leaves in the first week of May, in other backward seasons is not in full leaf before midsummer. (See Table of leafing of trees and shrubs.) This is also proved by the leafing of all trees about a week earlier in England than in Scotland. If the Oak were removed to the extreme north of Europe, it would not expand its leaves at all, and, consequently, would soon perish. The only ligneous vegetation of Lapland is the low creeping dwarf Birch, and two or three Willows. Elevation of temperature is the great accelerating cause of vegetation; where moisture is abundant, either in the tree or in the soil, heat is one of the most important stimulants of growth. The precise manner of its action upon the vital organs may be unknown, but its effects are unquestionable. The general effect of heat on all substances, except such as are of an argillaceous nature, is to cause them to expand or to occupy a larger space. The alternation of temperature is probably the cause of the periodic diurnal phenomena in plants, viz., the folding of the leaves of certain genera and species in the latter part of the day, also the expansion of certain blossoms early in the morning, towards mid-day, and towards the evening, or during the night. These diurnal phenomena may also partly depend on the agency of light, which is a well-ascertained stimulant in the vegetable kingdom. The effect of light, as one of the efficient causes of producing or contributing to the production of the annual phenomena of vegetation, is smaller than that of heat in causing the expansion of leaves; but in the periods of leafing and flowering, both are active and powerful stimulants. An increase of temperature causes the vessels and their contents to swell, and, besides this, it dissolves the gummy or viscid substances which retain the scales of the bud in a cohesive state. Thus it both relaxes the external envelopes and enlarges or swells the interior rudimentary organs. The effect of general mechanical laws upon all sorts of beings, whether organized or inorganized, can be stated; but the effect of another and different principle, called vitality, which probably modifies the action of the former, cannot be stated in definite terms.

It is known that vitality is a modifying power, principle, or great cause; for otherwise, if the same stimulating forces continued to act, the effects would be continuous, which is not the case either in the vegetable or in the animal kingdoms. Heat, or any other merely mechanical cause, constantly acting on inorganized matter, would be productive of similar effects as long as the cause continued in operation. But in plants this is not the case. Light, moisture, and heat are operative causes of phenomena in vegetables; but though they may continue long, after definite results are produced, they are inoperative on such plants as have already produced these results. Most of our hardy bulbous plants flower early, long before the heat has reached its maximum. Yet this agent, active though it be, and necessary as it is, exerts no influence on such plants as have completed the period either of their existence or of their activity. In the former case they are totally extinct, being resolved into their original chemical constituents; in the latter, they resemble a *caput mortuum*, without any visible signs of vitality till they have had a period of repose, when they again resume their active functions, under the stimulus of heat, moisture, and light. The cause of these periodic returns of activity and repose, both in animals and in plants, will probably remain for ever among the arcana or mysteries of science. The periods of the flowering of the most common genera, and species of plants, in the south of England (between lat. 50 and 52) are as follow:—

PERIODS OF FLOWERING OF PLANTS—DURATION OF PLANTS—PROPER TIME OF COLLECTING PLANTS BOTH FOR EXAMINATION AND FOR THE HERBARIUM.

44. GRAMINEÆ.—In the south of England the grasses begin to flower in May; during the first week of this month the *Annual Poa* (Poa annua) and the sweet-scented *Vernal grass* (Anthoxanthum odoratum) may be looked for. In early seasons these have been seen in flower as early as the middle of April, and even in March. In registers of bygone years these two, with *Alopecurus pratensis* (Foxtail meadow grass) are entered as early as the 20th of March. Most of the grasses flower in June, and only a few, viz.—the *Reed grasses* (Arundo, Calamagrostis), the *Bents*, *Agrostis*, *Triticum*, *Elymus*, *&c.*, flower in July and August. In the descriptive portion of this work, the earliest period is stated (when known), as also the latest date when the species in question has been gathered in flower, or perhaps in fruit. And it may be stated, once for all, that in general these dates are taken from registers which extend from the Spring of 1829 to the present date, viz.—the Summer and Autumn of 1853, a period of 25 years.

45. CYPERACEÆ.—The *Carex hirta* (rough Carex) *Carex præcox* (early Carex) flower between the middle of April and the first week of May. The two river *Carices* (C. riparia and paludosa) have also been seen in flower at the same date; but the month of May is the usual flowering month of this extensive genus, and most of them are to be found in June in a better state for comparison and preservation than at an earlier date, because they are generally in fruit at this latter period. The *Cotton grasses* (Eriophora) flower in May and June, and the *Club-rushes* (Scirpi) in June, July, and August; the *Eleocharis palustris* sometimes in May. The *Cyperi* flower in August and September.

46. The aquatic, or paludal orders, POTAMACEÆ (Pond-weeds), LEMNACEÆ (Duck-weeds), TYPHACEÆ (Reed-mace, &c.), JUNCAGINACEÆ, BUTOMACEÆ and ALISMACEÆ (Water Plantains, &c.), do not flower

till about midsummer, and many of the species of these orders are not in flower before August. *Zannichellia* has been noticed in flower in May, and *Butomus umbellatus* (Flowering rush) and *Potamogeton crispus* before the middle of June. The *Spotted-leaved Arum* (Arum maculatum) is usually in flower about the 1st of May, and not seldom by the middle of April.

47. JUNCACEÆ.—The earliest flowering species of the Rush order are *Luzula campestris* and *L. pilosus.* These are found, the former, in dry pastures, and the latter in woods, as early as the latter end of March and the beginning of April. The 13th of March is the earliest date in the registers above-mentioned for *L. pilosus; L. campestris* appears in flower about the same time. The great body of the rushes flowers between June and the beginning of August, most of them in July. *Juncus obtusiflorus* may be found in September in full flower. The pretty *Bog Asphodel* flowers about midsummer.

48. LILIACEÆ.—The beautiful species comprehended in the order of Liliaceous plants commence flowering in April, and some of them are in flower in August. They are, however, most plentiful in the earlier months. The *Chequered Daffodil* and the *Wild Tulip* are the earliest of the order; both of these very interesting species are found about the end of April or the beginning of May. The Tulip is the earlier of the two, but seldom flowers, while the latter is a free flowerer. The *Star of Bethlehem* flowers about the first week in May, and the sylvan *Blue Bell* about the last week in April. The *Ramson* (Allium ursinum) flowers in May or in the beginning of June, the *A. vineale* (Crow Garlic) about a month later. The remaining species of this genus flower between midsummer and August. The pretty and rare Grape Hyacinth (Muscari racemosum) and *Gagea lutea* are much earlier, the former appearing in May, the latter in April and March.

The curious, showy *Meadow Saffron* (Colchicum autumnale), the sole representative of the order COLCHICACEÆ in Britain, displays its naked flowers in September, or even later: it is, however, often to be met with in meadows in the West of England in August; the leaves appear the following spring.

49. ASPARAGACEÆ.—The *Convallarias*, viz., *Solomon's Seal*, the *Lily of the Valley*, *Wild Asparagus*, and the *Two-leaved Convallaria* (Maianthemum bifolium), all flower in May or early in June. The *Butcher's Broom* flowers in March and April. The 14th of March is about the earliest date in floral registers for the first appearance of this plant in flower. The *Lily of the Valley* has been collected in full bloom on the 29th April; its usual time of flowering in ordinary seasons is from the 12th to the end of May.

The *Snow-drop* and the *Common Daffodil* are almost the only species of the gorgeous order *Amaryllidaceæ* that we can with propriety call our own native plants, and they may be only naturalised. In gardens and sheltered orchards the *Snowdrop* appears at the beginning of February or earlier; but in woods, banks, and meadows where it grows—and it grows in such places abundantly—it is seldom in flower before March. Its flowering period fluctuates from the middle of January to the beginning of March. The *Daffodil* flowers from the 9th March to about Lady-day, the 25th. The *Summer Snowflake* flowers about the beginning or middle of June. The *Yellow Iris* or *Flag* is rarely in flower before the end of May, and the *Frog-bit* and *Water Aloe*, and *Gladwyn Iris*, not much before the middle of July.

50. ORCHIDACEÆ. The *Orchids* of this country do not begin to flower before April. The *Wood Orchis* (O. mascula) appears between the middle of April and the beginning of May, being usually in flower with the Cowslip; and the *Green meadow Orchis* (O. morio) does not linger long behind it (the Cowslip). The *Spider Orchis* (Ophrys aranifera) flowers in April and in the beginning of May, and the *Fly Orchis* (O. muscifera) towards the end of May or beginning of June. In June it is rather late to look for the two *brown spotted Orchises* in flower, viz., the *Dwarf* and the *Great spotted Orchises* (O. ustulata and O. fusca). They generally flower about the end of May, or in late seasons early in June. The great *Butterfly Orchis* flowers at the same date as the two just mentioned. The *Bee*, the *broad-leaved Marsh*, and the *Spotted-leaved Orchis* will, in the South of England, be found in full flower some time in June, early or late in the month, dependent, of course, on the season. The *broad-leaved Twayblade* (Listera ovata) and the *White Helleborines* (Cephalanthera grandiflora and ensifolia) usually appear in May or the beginning of June. *Lady's Tresses* and the *Marsh Green Orchis* (Malaxis paludosa) flower in August and September.

51. In general, the native British timber-trees are all early flowerers. The amentiferous or catkin bearing-trees, such as the *Alder*, the *Hazel*, the *Poplar*, produce their male flowers before winter, and their female flowers early in spring, when the male catkins expand and shed their fertilizing powder on the fruit-bearing organs. These trees are either all males and all females, as the Willows, Poplars, &c., or have male flowers on one part of the plant and the female flowers on another part, either distant or more or less contiguous, as the *Chestnut*, *Beech*, the *Alder*, the *Hazel*, some of the *Willows*, and the *Yew*. The *Hazel* has been noticed with open catkins and the red, hairy stigmas of the ovary as early as the 22nd of February; and the Willow, vulgarly called *Palm* (Salix aurita), and the *Yew*, on the 8th of March. The *Beech*, the *Oak*, and the *Hornbeam* flower in April and May. The *Poplars* in March and April. The *Pine* in May. Most of the *Willows* in April and May, though some are as early as March, and a few delay till June.

The *Elms* bear flowers in March or April, shedding their immature fruit soon after. These trees increase by the roots, and rarely bring seeds to perfection.

The two common *Nettles* and *Wall Pellitory* are in flower from Midsummer to September or October.

52. EUPHORBIACEÆ.—The Spurge and other kindred plants of this order vary much in their periods of flowering. For example, the *Wood Spurge* (E. amygdaloides) flowers about the beginning of April

(per reg. 4th, 7th, 16th). The common Spurge (E. Helioscopia) from the beginning of June to the end of summer. The other two common species—viz., *E. Peplus* and *E. exigua* are somewhat later in beginning to flower, and continue flowering nearly as long as the common *Sun Spurge.* The rarer *Spurges* have generally a shorter period for flowering—viz., from May to August, but several, as the *E. Paralias, E. Portlandica,* and *E. Lathyris* remain in flower till September. The pretty shrub *Box* flowers in April, the *Dog Mercury* in April (from 25th March to the 20th April). The Annual Mercury commences flowering in May, and continues till the winter's frosts nip both blossoms and plants. The *Crowberry* (Empetrum) flowers in the earlier part of summer, and in autumn the fruit affords sustenance for the moor game (grouse) of the north of England and Scotland, where this shrub abounds. The rare *Asarum* (Asarabacca) flowers in May, and the rarer *Aristolochia* (Birthwort) flowers in July and August. It seldom or never produces fruit in this country. The next three orders SANTALACEÆ, THYMELEACEÆ, and ELEAGNACEÆ are represented in this country by only four plants, all more or less ligneous. The *Toad-flax* (Thesium) flowers about Midsummer, the two *Daphnes*—viz., the *Spurge Laurel* and *Mezereon* flower early, the latter about the middle of March, the former a little earlier (16th March, 7th ditto). The *Buckthorn* flowers in May.

53. POLYGONACEÆ. The plants of this order are all late flowerers, except the *Common Sorrel* and the *Sheep's Sorrel,* which flower in May; all the other species, both of *Dock* (Rumex) or *Snake-weed* (Polygonum), flower after midsummer, the majority of the latter genus flowering in August and September. The *Goose-foot* order, CHENOPODIACEÆ, is also an order of late-flowering plants, rather later than those of the preceding order.

54. LABIATÆ. Some one or other of the plants of this order may be seen in flower during the whole year. If the winter has been mild—or, rather, if the months of December and January have not been severe—the *Lamium album* and *L. purpureum* (the white and red Deadnettles) will be in blossom during the first, second, and all the succeeding months of the year. The white Deadnettle has been observed in flower on the 15th—30th of January, and the red Deadnettle on the 29th of the same month. Their true period of flowering, however, is not so early; but the flowers of the previous year may generally be found on plants growing in sheltered spots at the very beginning of the year, unless the weather has been very inclement. In March the *L. purpureum* covers rich rubbish-heaps with its reddish stems and leaves, for they have this hue in the earlier part of the season. The 16th March, and from this date to the end of the month, is the period when these two hardy plants blossom; and their period of full flowering is not later than April in this part of England. Several species of *Lamium,* viz., *L. amplexicaule, L. incisum,* and, perhaps, *L. purpureum,* bear fruit, although their corollas have never expanded, or even reached the upper limb of the calyx. They are actually in fruit before the expansion of their

flowers. In cold, wet seasons, the flowers of *L. amplexicaule* are never fully developed, yet the plant produces seed. The *Yellow Deadnettle* (L. Galeobdolon) does not flower till May: the 25th of April is the earliest registered date. The *Ajuga reptans* (wood or wild Bugle) will be found in flower at the same period. The *Yellow Bugle* (A. chamæpitys) is occasionally seen in blossom as early as May. The fine plant, *Salvia verbenaca*, is also an early flowerer: its period is May, or the beginning of June. The period when the *Ground ivy* (Glechoma hed.) first shows its blossoms fluctuates with the weather; the 4th, 5th, and 15th of March are the earliest periods noted. Its usual time of flowering is at the middle and latter end of March. All the other Labiate plants, as the *Thyme*, the *Wound-worts* (Stachys)—of these last mentioned *S. sylvatica* is the earliest — the *Wood-sage*, *Marjoram*, *Mint*, &c., do not flower till after midsummer, and some of them are as late as September, while several of the mints do not flower at all in the northern parts of the kingdom.

55. SCROPHULARIACEÆ. As in the preceding orders so also in this, several individual plants are always in flower. The annual *Speedwells* (Veronica agrestis V. polita and V. hederifolia) are found flowering as late as December, and begin to flower in mild winters in the first and second months of the year. *V. agrestis*, 28th January, 9th February, 12th, 16th, and 20th March; *V. Hederifolia* a little later; *V. arvensis* is early if in flower much before April, the 4th of March is the earliest date at which this plant has been noticed in flower. *Paul's Betony* (V. serpyllifolia) flowers about the same period. The pretty *Bird's-eye* (V. chamædrys) is about a month later. The following are a few of the dates of its first appearance in flower, 4th, 5th, 26th, and 29th of April. Its usual period is from the middle of April to the beginning of May. The earliest *Water-speedwell* is the *Common Brooklime* (V. Beccabunga), which flowers in early seasons from the 14th to the end of May. The remaining *Veronicas*, except the rare *V. verna* and *triphyllos*, and most of the plants in all the other genera of this order, do not flower before June. The *Ivy-leaved Toad-flax* (Linaria Cymballaria) may be looked for on old walls about the beginning of April. It has been seen in flower as early as the 4th. It is the only species of the genus which flowers before June. *Pedicularis sylvatica* has been gathered in flower as early as the 1st of May, and the *Yellow rattle* (Rhinanthus crista-galli) on the 15th. The rare *Vernal Figwort*, and the *Foxglove*, are the only other species of the order in flower before Midsummer, and the latter is usually after this period. The remaining plants of this order flower in the end of June, in July, and in August; the great *Snapdragon*, and some of the *Linarias*, continue flowering through September.

56. The *Broom-rapes* and the *Mulleins* are all late flowerers, none being seen in this state before Midsummer, except *Orobanche rapum*, *O. majus* and *O. elatior*. *O. minus* always appears soon after the hay is mown on the uplands. The *Mulleins* (Verbasca) are not in flower before July or August. The comparatively rare *Henbane*

usually flowers in May. The *Nightshades*, both the deadly and woody, in June, towards the middle or end of the month. The *Woody Nightshade* (Solan. dulc.) has been seen in flower on the 2nd of June, but the season then was unusually early. The *Black Nightshade* is found, both in flower and fruit, as late as October.

57. BORAGINACEÆ. *Myosotis arvensis* (intermedia). One of the *Mouse-ears* has been observed in flower about the beginning of May: the dates are, 29th April, 3d and 12th May. *M. collina* and *M. versiculor* are, at least, a fortnight—or, perhaps, three weeks—earlier. *Myosotis palustris* (Forget-me-not) has been gathered in flower on the 27th May. The *Pulmonarias* are early flowerers, but they are very rarely seen, except in gardens or collections. The *Gromwells*, *Comfrey*, *Hound's-tongue*, both species, and the *Viper's Bugloss*, flower in May; but they may all be found in flower in the beginning of June, unless the season be unusually early. With the exception of the genus Myosotis, which flowers both early and late in the season, none of the species of this order are late flowerers.

58. CONVOLVULACEÆ and CUSCUTACEÆ. In early seasons the *Field Convolvulus* flowers in June, rarely so early as the 15th. The large *White Convolvulus* ornaments the hedges from the 10th of July to the end of September. The *Less Dodder* appears on heathy, furzy commons, twining about Ling, Pettywhin, Gorse, &c., about the same time. The *Great Dodder* appears in August. The *Gentianas*, and other plants belonging to the order *Gentianaceæ*, except the *Bog-bean*, are all late in flowering; the *Bog-bean* should be looked for, at latest, before the end of May. The 27th of May is the date when it was first noticed in a very cold, backward season. The *Villarsia nymph*: and the *Centaureas* appear in flower about midsummer, or soon after. The *Vernal Gentian* alone flowers in April: the remainder of this order in August and September. Both species of *Periwinkles* are early flowerers. *Vinca minor* has been seen in flower as early as the 7th March, and *V. major* as early as the 23d February. Of course, like all early flowerers, they continue a long time in blossom.

The *Privet*, *Ash*, and *Holly*, flower in June.

59. ERICACEÆ. Most of the *Heaths*, *Bilberries*, *Winter's-greens*, and allied genera, commence flowering in June—a few in May. *Erica cinerea* has been noticed in a sheltered spot, with a southern aspect, in flower on the 28th May; but midsummer is the usual period of its flowering. The *Cross-leaved Heath* and the *Common Ling* appear in flower somewhat later. The rarer species of the order are not in flower before July, except one of the Pyrolas, and one of the Heaths peculiar to Ireland.

60. PRIMULACEÆ. Certain species of this order are in flower very early; some are late, and continue flowering from the latter end of summer to the commencement of severe weather. The dates of the first appearance of the *Primrose* in flower fluctuate between the beginning of February and the middle of March, viz., 29th January, 12th, 13th February, 7th, 13th, 14th March. The *Cowslip* is several

weeks later; its dates vary from the 8th March to the 8th April. It should be borne in mind that these species, and several others which flower at these early periods, are not in full blossom for some time after these specified dates. After their first appearance in flower, they will generally be from ten to twenty days, according to the mildness or severity of the weather, before they ornament the woods, hedges, and meadows with their fully-developed beauties. The same influences which accelerate or delay the fulness of blossoms, have a tendency to hasten or retard their decay. With a clear atmosphere and high temperature they speedily decay, while their duration is protracted by cool, moist, or cloudy weather. The Primroses peculiar to Yorkshire and Scotland are not in flower till June and July. The *Water Milfoil* (Hottonia) may be found flowering in May, but it will not be too late to look for it from the beginning to the middle of June. The *Lysimachias* (Loosestrife), except *L. nemorum*, which flowers in May or the first week of June, the *Pimpernels*, *Brookweed*, &c., are all late flowerers, and some of them are found in flower as late as October. The blue *Pimpernel*, in mild seasons, produces flowers in November.

61. PLANTAGINACEÆ. *Ribwort* (Plan. lanceolata) occasionally flowers about the middle of April. Its usual period is the latter end of April and the beginning of May (April 27). *Plantago coronopus* has been collected in flower the first week of May (the 5th). *P. major* and *P. media* are a week or so later.

62. PLUMBAGINACEÆ. The *Thrift* flowers about midsummer, or soon after: the *Sea Lavenders* rarely before July.

The *Common Butterwort* (Pinguicula vulg.) flowers in May: the rarer Alpine species are about a month later. The *Utricularias* flower from midsummer to August.

63. COMPOSITÆ. Some one or other of the species composing this large order is always in flower. For example, the *Common Groundsel* (Senecio vulgaris) flowers early in the spring (12th—17th February), and continues in flower till the sharp frosts and biting dry winds of winter nip its more delicate parts. When the winters are rather mild, or not severe, the flowers of autumn exist through the winter and early spring. And this is the case not only with the flowers of the Groundsel, but also with those of the common annual Veronicas, the Henbit, Deadnettle, &c. All these plants produce their flowers every month in the year—or, at least, retain them. One of the earliest flowerers of this order is the *Dandelion*, which begins to flower between the 15th February and the 1st April. But the flowers first seen are, probably, the production of the previous season. It continues to flower from March to November, a period of not less than nine months. These two plants, viz., Groundsel and Dandelion, with the *Common Daisy*, are the only early flowers to be seen among the common species of this order, and these three remain in flower during the whole year. There are other two early-flowering rather common plants, viz., the *Coltsfoot* and the *Butter-bur*. The dates of the former are between the 14th and 29th March; the latter is a

week or two later. Both these plants are remarkable for flowering a few weeks before the appearance of their leaves. *Cineraria campestris* flowers in the latter part of May and beginning of June: a rare plant. The Common Mouse-ear Hawkweed begins to flower from the 5th to the 23d May. These are all the early-flowering common plants of this order. The great body of them does not flower much before July, and from that period to September. *Hieracium boreale* and *H. umbellatum* do not flower till the end of August. Both species of *Bidens*, viz., *B. tripartita* and *B. cernua*, also *Hemp Agrimony*, *Pulicaria vulgaris*, several of the *Wormwoods* and *Ragweeds*, are often as late as the beginning of September before they flower. The *Goat's-beard*, the large *Ox-eye Daisy*, and the *Corn Chamomile* generally flower before or about midsummer. In the month of August the greatest number of species will be found in flower.

64. CAMPANULACEÆ. Of this order *Prismatocarpus* and *Jasione* rarely flower in May, but usually before or about Midsummer. Most of the *Campanulas* will be found in flower during the month of July: they go off rather suddenly. Several of them, as *C. Trachelium* and *C. glomerata*, remain in flower till September; but, as above stated, July and the beginning of August is the period when they are all in flower. The *Rampions* (Phyteuma) flower at the same time as the Campanulas. Plants of the *Teasel* and *Scabious* kinds are generally in flower in the month of July, but they keep in flower during August. *Scabiosa succisa* is seldom in flower before August, and it continues to flower all the next month.

65. VALERIANACEÆ. The common *Fedias*, or *Valerianella's* (Lamb's Lettuce) flower in March and April; *V. olitoria* between 7th March and 23d April; *V. dioica* about the 20th May; *V. officinalis* the 29th May, rarely before June, usually near midsummer.

66. RUBIACEÆ. The dates of some plants of this family are as follow:—*Sherardia arvensis*, April 2nd; very early. *Asperula odorata*, 28th May. *Galium Aparine*, 8th May. *Galium mol.* 18th May. *G. cruciatum*, 2nd June. *G. saxatile*, 10th June. About the end of June and the whole of July is the season for all but the very latest of these plants. The *Marsh Cross-worts* are a fortnight later than the preceding.

67. The shrubby, or arborescent orders, LONICEREÆ, CORNACEÆ, ARALIACEÆ, and LORANTHACEÆ, include plants that flower almost in every one of the four seasons. For example, the *Ivy* flowers at the beginning of winter, viz., in October and November, remaining in flower till the spring, when it produces fruit. The *Misseltoe* flowers in March and April, and has ripe fruit, as is well known, in winter. The *Honeysuckles* flower in May and June. The *Elderberry-tree* and the *Guelder-rose trees* flower about the same time, and their fruit is perfect in September and October.

68. UMBELLIFERÆ. The earliest flowering common plant of this order is *Anthriscus vulgaris* (Hare's Parsley), which begins to blossom about the middle of April, but is frequently later: and is not perhaps generally in flower before the latter end of the month, or about the

beginning of May. *Anthriscus sylvestris* may be looked for about the same time, or two or three days later. *Pignut* (Bunium), *Venus' Comb* (Scandix), *Cow Parsnep* Heracleum), *Sanicle* (Sanicula), usually begin to flower in May. The Pig-nut has been seen as early as the 12th; the others rarely before the beginning of June or end of May. In June most of the early-flowering umbelliferous plants may be collected, both in flower and fruit (the latter is more important for identifying the genus than the former). The remaining common species will not be generally found in a state fit for examination before July. A few delay flowering till August, as some of the *Water Parsneps;* all these late-flowering species will be found in September.

69. SAXIFRAGACEÆ.—The *Golden Saxifrage* (Chry. oppos.) is the earliest flowering plant of this family. It has been noticed as early as the beginning of March in forward seasons. The 9th and 15th March, and from the latter date to the beginning of April, is the time to look for this early plant; but it may be found during several months, for it continues flowering till late in the summer. The rarer *Ch. alternifol* is rather later, and does not remain so long in flower. *Saxifraga tridactylites* flowers in March and April, and *S. granulata* always in April, in this latitude usually about the middle of April. The remaining species of this large genus flower in May and June, the *S. oppositifolia* in April, and a very few are not usually in flower till August.

70. The *Currant* and *Gooseberry* shrubs are all early flowerers, never later than April; their dates are from 29th March to the 20th April. From the 10th to the middle of April is the time when they usually flower.

71. Of the order CRASSALACEÆ there is only one plant, *Sedumacre*, common in this country, and it usually flowers in June. *White Bryony* (Bryonia dioica), one of our largest climbers, generally flowers in May. The 6th of this month is the earliest registered date of its appearance, and it is sometimes as late as the end of the month. The 30th is also noted as the day of its first appearance. The *Black Bryony* (Tamus com.) begins to flower at the same time.

72. *Montia fon.* (Water Blinks), and *Callitriche* (Water Star-wort); flower in May, the former about the middle of April (11th, 17th), and the latter at the end of the month, 30th. The *Water Hornwort* (Ceratophyllum), and the *Water Milfoil* (Myriophyllum), seldom are found in fruit. They flower about the end of June, or later.

73. ONAGRACEÆ.—These plants are in perfection about the end of June and in July. *Epilobium parviflorum* has been noticed in blossom on the 3rd June. *E. montanum* appears about the 18th, and by midsummer all the species are in flower. July is the time to collect them for the herbarium, or for examination. At this time they are in perfection.

74. ROSACEÆ AND POMACEÆ.—The *Barren Strawberry* has been seen in flower in February (the 23rd). March is the usual month when it may be expected. The *Black Thorn* rarely flowers before the middle

of April. It has been seen as early as the 8th of March, but this is quite unusual. Its registered periods are the 7th, 8th, 9th, 20th, 23rd, and 26th of April. The *Cherry* and the *Common Pear* are only a few days or a week later in their appearance. They may all be found in blossom at the same time. The *Apple-tree* is in blossom in the last week of April, or the first week in May in early seasons. The dates are 26th April, the 1st and the 4th of May. In late seasons it is not in flower before the middle of May. The *Rowan Tree, Whitethorn beam and Service trees* are a week or two later than the Apple-tree. The following dates are registered for the flowering of the May (common Hawthorn, Cratægus Oxy.), April 24th, the 1st, 9th, 10th, 15th, 16th, and 21st of May—a variation of nearly a month. *Common Avens* (Geum urbanum), 4th May; *Common Cinquefoil* (Potentilla reptans), 14th; and *Tormentil* (P. Tormentilla), the 12th and 18th; *Silver Weed* (P. Anserina), 30th of the same month. These are the earliest dates, and they continue in flower for weeks (months?). The *Strawberry* flowers in May, earlier or later. according to the season. Of the *Brambles*, the *Raspberry* and the *Dewberry* have been noticed in flower before Midsummer; in early seasons before the end of May. *R. corylifolius* is registered on the 2nd June. The *Dog Rose* has been gathered on the 21st May; the *R. Arvensis* about the 18th June; and the *Sweetbrier* on the 5th. *R. spinosissima* is generally in fruit about the end of May. The Roses and Brambles may, however, be found in flower during the months of June and July with this difference, that the Roses almost all vanish in July, while most of the Brambles remain in flower during the next month (August).

75. LEGUMINIFERÆ.—The *Common Gorse* (Ulex europæus) is sometimes in flower all the winter, for the second crop of flowers lasts till next spring. The *Dwarf Furze* (Ulex nanus) flowers very late, October and November. Where it grows with the larger species or variety, as it does abundantly on Wandsworth and Clapham Commons, the time of flowering is a very obvious distinctive mark between the two plants. The dwarf species is covered with blossoms, as above, while not a single flower adorns the common and larger form. With these exceptions, none of the plants of this order are early flowerers. The *Wood Vetch* (Orobus tuberosus) has been noticed in flower as early as the 17th April, and at various dates intermediate between that just stated and the beginning of May. The *Vetches* or *Tares* (V. sativa and sep.) flower in May (15th and 28th), the large *Blue climbing Vetch* about the middle of August; the *Lotus cor*, or Birdsfoot, about the end of May (23rd); the *Horse-shoe Vetch* (Hippocrepis com.) 5th and 19th May; the *Lathyrus prat.* (Meadow Vetchling) about the middle of June (12th); the *Golden Broom* (Sarothamnus scoparius) about the 1st of May; and the *Petty Whin* (Genista anglica) about a fortnight earlier. The Meadow Trefoil flowers in May (1st and 15th), and the *White Clover* (S. repens) about the same time (13th), but much later in moist places, where it is frequently found. Most plants in this order flower about, or soon

after, midsummer; only a few flower towards the end of July. Most of them, however, perhaps all, except the very earliest, will be found in good condition for examination during July.

76. GERANIACEÆ.—The *Geraniums* commence flowering in April, viz., *E. cicutarium* (Storks-bill), and *G. Molle* (Dove's-foot Crane's-bill), from the 6th to the 21st April, though the latter is often as late as the beginning of May ere it shows flowers. *Herb Robert* (G. robertianum) begins to flower at the beginning of May (1st, 3rd, and 10th). *G. lucidum* appears about the same time. The rest flower in June, but they all remain in flower for some months.

77. The beautiful *Oxalis Acetosella* (Wood Sorrel) may often be found in the same places as the *Wood Anemone*, and it flowers about the same time, or rather earlier. Its dates are 29th March, 1st, 6th, 7th, and 11th of April. The *Wood Violet* (V. sylvatica) is later—viz., the 13th, 20th, and 25th of April are some of its dates. In gardens and sheltered places (where the Sweet Violet only is found), *V. odorata* flowers in the beginning of March, and even in February, in mild seasons (22nd and 23rd February). The two species of *Buckthorn* and the *Spindle Tree* (Euonymus europ.), 12th and 26th May. The latter from the 12th to the 26th May; the two former between the middle of May and the beginning of June. The *Wild Maple* (Acer campestre) about the 8th of May, or later; and the *Sycamore* (A. Pseudo-platanus) about the same period. The common Lime is seldom in flower before July. The *St. John's Worts* (Hyperica) are July-flowerers. *H. pulchrum* and *H. humifusum* are the earliest in blossom; the latter has been gathered in flower on the 12th June.

78. *Malva rotundifolia* is the earliest flowering plant of the Malvaceous order. It begins about the end of May (28th), and flowers till September; *M. sylvestris* is about a fortnight later (13th June); and does not continue in flower quite so long. The *Musk Mallow* (M. moschata) flowers in July. The *Marsh Mallow* (Althæa of.) does not flower till August. The *Milkwort* (Polygala vulgaris?) commences flowering about the second week of May (12th), and continues in flower all the summer. The *Droseras* flower about midsummer, or the beginning of July.

79. CRUCIFERÆ.—The *Shepherd's-purse* (Capsella) is in flower most of the year. It is one of the earliest, as it is one of the latest, flowering plants. It is, however, later in beginning to flower than the Groundsel. It may be looked for in the second week of March, and may be often seen flowering in February (21st February, 10th and 13th March). The *Vernal Whitlow-grass* (Draba Verna) will generally be found about the same time; but the flowers of the latter are of short duration, rarely existing till the 1st of May. In January, 1853, the *Wall Whitlow-grass* was noticed in several places about Twickenham in flower at the very beginning of the month (the 3rd), along with *Arenaria serpyllifolia* and *Common Groundsel:* but there was at that time and place no Shepherd's-purse in flower. The November of the preceding year, 1852, had been remarkably mild (six degrees and a-half above the average temperature of many pre-

vious years), and December about nine degrees milder than any December during the last eighty years. The *Wallflower* blossoms, in early seasons, about the middle of March (10th, 15th, 25th March, and 2nd of April). It blossoms with the *Cuckoo-flowers* (Cardamine prat. and hirsuta). The latter, or rather *C. sylvatica,* has been gathered in February (20th); and the beginning of its flowering is noted on the 24th, 25th, and 28th of March. The *Meadow Cuckoo-flower* is about a month later—viz., at the end of March, and first week of April (30th March and 10th April). *C. amara* (Bitter Lady's Frock) is several weeks later. Johnson, the editor of "Gerarde's Herbal," noticed the flowering of these plants in the following terms:—"These flowre for the most part in Aprill and May, when the cuckou begins to sing her pleasant notes without stammering." They are rather before the cuckoo's notes in the south of England. *Jack-by-the-hedge* is always in flower in April, or early in May. Its dates are April 7th, 21st, and 28th; and its white blossoms are very conspicuous about the end of April and the beginning of May. May and June are the chief months for the blossoming of the *Crucifera,* only a few delay flowering till July and August; but several continue in blossom till September, or even later.

80. The *Resedas* and *Cistuses* flower in May and June; *R. lutea* about the middle, and *R. luteola* about the end of the month. Both the latter and *Helianthemum vulgare* have been seen as early in flower as the 27th May.

81. The *Fumarias* flower in May and June, and last in flower all the summer.

Corydalis Claviculata has been gathered in flower on the 8th May; and *Fumaria of.* (?) as early as the 20th of April.

The Poppies begin to flower in May. *P. Argemone* has been noticed in flower on the 13th; the *greater Celandine* has been first seen in flower on the 21st and 28th April, and on the 1st and 6th of May. These plants are in flower in June and part of July.

82. CARYOPHYLLACEÆ.—*Common Chickweed* (Stellaria media) is in flower nearly all the year. In mild winters it appears in January. The following are the dates of its first appearance:—28th January, 14th, 15th, 25th February, and 28th March. *Stellaria Holostea* (Stitchwort) begins to flower about the last week of April, 24th, 28th, April, and 6th and 11th May; *S. graminea* on the 18th May, and *S. uliginosa* about the same time. *S. glauca* is rare, and seldom found in flower till after midsummer. *Cerastium glom.* and *C. triviale* are usually in flower about the end of March and beginning of April. (20th March, 2nd, 5th, and 9th April). The *Arenarias*, viz., *A. trinervis, A. rubra,* and *A. serpyllifolia,* do not usually flower before May. In early seasons the first-mentioned may be seen in flower from the 10th to the 20th of April; *A. rubra* the 13th May, and *A. serpyllifolia* about the 15th of the same month. The *Red Lychnis* (Melandrium diurnum), appears in flower occasionally as early as the beginning of May. It has been gathered in full flower on the 26th April, and it is rarely so late as the latter end of May.

M. Flos-cuculi, or Meadow Pink, is about a week later, viz., from the 8th to the 20th May. This is the real cuckoo flower. When this plant begins to blossom the cuckoo does sing his pleasant notes without stammering. Both these plants remain in flower all through the summer. The *White Campion* (M. vespertinum) is later than either of these. Its flowering time is June, usually near the beginning of the month. At this period the *Corn Cockle* (M. Githago) is in flower.

The *Hellebores* are among our rarest plants, and they flower early, viz., in March and April. Like all early flowerers, their flowers endure for several months.

83. RANUNCULACEÆ.—The blossoms of *Celandine* (R. Ficaria) or (F. ranunculoides) appear early. The 13th of February, the 17th and 20th of March, are registered dates of its first appearance in flower. *R. auricomus* (Wood Crowfoot) is sometimes seen in flower as early as the middle of April; the 4th, 11th, and 29th are noted. But it will be found in better condition, both for examination and for the herbarium, in the month of May, when it begins to be in fruit. The pure white flowers of *R. aquatilis* (?) may be seen covering the surface of ponds about the same time. This is rarely seen in full blossom so early as the 8th of April. From the 17th April to the 8th of May it usually begins to flower. Like many, or most other spring flowers, it will be found in a better state for investigation or preservation a few weeks or a month later. *R. hederaceus* (Ivy-leaved Crowfoot) will be found about the same times. *R. bulbosus*, when early, flowers at the very end of April, 29th and 30th. Its usual period is the middle of May. *R. acris*, *R. repens*, and *R. Flamula* are somewhat later than the *bulbous Crowfoot*. *R. acris* has been noted as in flower at the beginning of May (3rd); but the dates 15th and 18th of May are nearer the mean time in this latitude. *R. repens* and *R. arvensis* are the latest of the more common *Ranunculi*. The dates of the *Marsh Marigold* (Caltha palustris), a very conspicuous plant and flower, are as follow—the 13th, 20th, and 25th of March, and the 18th and 24th of April; the latter dates are unusually late. The *Wood Anemone* (Anemone nemorosa) is rather earlier than the *Marsh Marigold*. It has been seen in flower as early as the 8th March; but between this date and the 30th March, and from this to the 17th April, are more usual dates. *Meadow Rue* (Thalictrum flavum) is comparatively rare; but it should be looked for about the end of May, or at the beginning of June.

84. The *Water Lilies*, both the Yellow and White, do not flower before June. The 10th and 16th respectively are the earliest dates at which they have been seen in blossom. They remain in flower during the months of June and July.

85. The principle on which the flowering period has been denoted in the descriptive part of this work is the following:—When definite periods of the month are entered, the first is the very earliest time at which the plant has been noticed in flower, and the second is the latest; and it should be remembered that these dates are only applicable to the plants that grow chiefly to the south of London, or from 50½° to 52°.

When the flowering months only are set, it is to be inferred that the exact date is unknown, and that the plant will be found in flower some time in the month. When two months are entered, as for example, March and April, it is to be inferred that it may probably be found in both, but generally towards the end of the former; and during the whole of the latter generally. When a (—) follows a month, and is succeeded by another month, as May—August, it denotes that the plant will be found in flower during the intermediate months of June and July, as well as in May and August. From what has been stated above, as the result of more than twenty years' observation, it may be inferred that it is impossible to fix an exact date when any plant first flowers in any assigned latitude. And it is quite impracticable to approximate to the average time of the flowering of plants extending over a space of nearly 10° latitude. Difference of latitude causes a difference in the time of flowering—so does locality; but temperature and moisture have, as we have seen, a very powerful influence on plants, either in retarding or accelerating their periods of flowering. This fluctuation is as much as a month in March and April—probably a fortnight or three weeks in May, and at least a week at midsummer. If local circumstances—viz., soil and exposure—were uniform, we could, indeed, approximate very closely to the period when these common plants flower, by comparing the average temperature of past years and months with the temperature of the year in which we wanted to know when a given common plant might be expected in flower; but soil and situation are susceptible of so many modifications, that a close approximation is not to be expected. In the early part of the year rain delays the flowering of plants; at this time the earth is usually sufficiently moist, and plants only want heat to accelerate their growth. Towards midsummer they are often delayed from a deficiency of moisture. In general, the monthly average of heat will have a greater effect on plants than the annual average. The monthly averages exhibit a fluctuation of several degrees. For example:

January, 31°·5; Fah., 34°, 35°, 37°, 38° 32′, 40 66′; a range of above 9° in seven years.

February: 34° 33′, 34°, 40°, 43°, 38°, 42° 25′; range of 9°.
March: 37° 25′, 42° 22′, 42° 25′, 45°, 42°, 44° 5′, 46°; range 8° 75′.
April: 47°, 49°, 52°, 50° 5′, 49° 75′, 53°, 49° 5′; range 6°.
May: 54°, 59° 75′, 56° 5′, 54°, 53° 5′, 63° 33′; range 10° 28′.
June: 68°, 60°, 59°, 60°; range 9°.
July: 70°, 62°, 62°, 61°; range 9°.
August: 58° 66′, 70°, 63°, 67°; range 11° 34.
September: 57° 5′, 59°, 60° 5′, 51° 5′; range 9°.
October: 45° 75′, 56° 5′, 49° 5′, 47°; range 10° 25′.
November: 43°, 44° 3′, 43°, 40° 82′; range 3° 21′.
December: 39° 5′, 44°, 42° 75′, 41° 66′; range 4° 95′.

The annual averages are between 49° 75′ and 51° 5′; range 1° 75′.

The average monthly temperature fluctuates about 8°, according to the above, while the annual average fluctuation is under 2°; and, if accurately determined by proper instruments, would rarely or ever much exceed one. The general average range, in any given latitude, is not probably above half a degree. The above results were obtained from a series of daily observations, made at 7 a.m., 1 to 2 p.m., and 8 p.m., extending over a period of from five to seven years. It is probable that the general statement of monthly and annual temperatures is too high, as the thermometer was not observed during the night, and a self-registering instrument was not employed. This, however, does not affect the monthly or annual ranges. The annual average temperature of London and its vicinity, *i. e.*, within twenty or thirty miles of the metropolis, is about 50°. The annual average temperature of the south of Devonshire is probably one degree higher, 51°; and it appears that the temperature of the north of Sutherlandshire, Scotland, is 46°. The early flowering plants are nearly a month later in the north of Scotland than they are here; for example, the *Common Primrose*, which flowers here in March and April, flowers in Aberdeenshire in April and May. The *Menyanthes trifoliata* is not more than a fortnight earlier with us than it is in Scotland; and it is probable that the midsummer flowers are only a week later in the northern parts of the island, while the July and August flowers are as early in Scotland as in England. The temperature of the summer months in Scotland is about as high as in England; but the difference of temperature in England and Scotland during the spring months is very considerable.

LEAFING OF TREES AND SHRUBS.

Elm: 21st, 27th of April, and 4th of May.
Beech: 19th, 25th, 27th of April, 1st and 6th May.
Oak: 25th and 29th of April, 1st, 3rd, 8th, and 16th of May.
Chestnut: 6th and 25th May.
Mountain Ash: 7th, 22nd, and 25th April.
Cherry Tree: 6th and 7th April.
Ash: 9th, 15th, and 16th May.
Hazel Tree: 1st April.
Hawthorn: 1st and 23rd April.
Honey Suckle: 14th January.
Gooseberry Bush: 17, 20th, 25th, and 29th March.
Dog Rose: 1st and 14th April.
Birch: 7th, 20th, and 25th April.
Blackthorn: 21st and 25th April and 4th May.
Hedge Maple: 20th, 23rd, 25th April, and 9th May.

ASCENT OF THE SAP.

86. The ascent of the sap, as it is termed, depends partly on what may be called mechanical, and partly on vital causes. Heat and moisture are the external stimulating causes; vitality is the modifying cause. By the former the sap is forced into the superior and recently-formed cells; and when the vital energy, or *vis formativa,*

relaxes, the sap remains more or less stationary. In the beginning of summer the productive force of the plant or tree is usually expended, and a cessation of activity is apparent. At the end of summer, or the beginning of autumn, there is in most trees a secondary flow of the sap, and leafy shoots are produced on certain parts of the tree. These shoots and leaves are called midsummer shoots, and may always be distinguished from the earlier leaves by their bright green colour. The mechanical energy is modified by the vitality, and a cessation of growth in one direction is the result. The elimination of the sap, the processes of elaboration and assimilation, are carried on internally; but the upward extension of the plant ceases soon after the full development of the leaves. The few shoots produced at a later period are evidence that the mechanical agents are only in abeyance, not suspended. But in the period which intervenes between the fall of the leaf, and even before the fall of the leaf in autumn, and the swelling and relaxing of the buds in spring, the mechanical power is in complete suspension. The processes of condensation of sap, and induration of wood, in permanent stems, may, and probably are, in active progress; but there are no external signs of activity about the plant or tree. Every part of the plant which is in a vital state (it has been shown, *Physiol.* p. 37, that certain parts of a still vital plant are dead, as much so as timber felled for years, it may even be decayed, or totally absent) is full of sap or air (nature abhors a vacuum). During this dormant state neither the liquid nor gaseous fluids can rise, because there are no newly-formed vessels into which they may flow, or may be impelled by the mutual pressure on the cell walls, caused by mutual expansion of all the tissues by heat. The sap cannot descend, because the vessels below are all filled with whatever may be the contents of the cells. That the sap ascends is a fact well ascertained; that it also descends is rather a fiction than a fact—a deduction from a supposed analogy between the sap of plants and the circulating fluid in animals. The economy of plants is more analogous to the intestinal canal of animals than to their circulating system. In both plants and animals the food enters by one extremity, and the excrementitious parts pass away by the other; but here the analogy ceases, for plants have no organs similar to the stomach, intestinal canal, lymphatic ducts, &c.; and nothing like the complicated systems of circulation and respiration necessary to animals Every cell, in every living organ, must be more or less distended; it must be full of fluid, either liquid or aerial, otherwise it would collapse, or be oliterated, and cease to be a vital, integral part of a living organism.

The ascent of sap is ascertainable. It must have ascended into the topmost twigs; and as it is originally derived from the soil by the roots, it must have had a progressive ascent, slow, no doubt, but gradually ascending with the elongation of the tree. The descent of the sap is inconceivable, except artificially, by tapping the tree, because there is no natural egress for it below. It has never been imagined that it escaped by the spongioles of the root. The formation of wood is an obscure subject, and has been rendered obscurer through the perplexing hypotheses and experiments that have been devised or instituted with the view of explaining it. Whatever may be its origin, it does not originate in the descending, condensed, and indurated sap. There is no sufficient proof that the sap ascends into the leaves—that it is elaborated in them, and returned thence fit for assimilating with the plant; as in animals the blood which has been purified from its carbon by contact with air in the lungs returns into the heart, and thence distributes nourishment and warmth through the whole body. We know that the wood is formed simultaneously with the other tissues, the pith, the medullary rays, and the bark. As a plant increases in length it also increases in diameter (if dicotyledonous). The woody part of herbaceous stems is formed long before the sap ceases to ascend—often before the leaves are developed, and always before the seed or fruit is mature; but, until the period of maturation is completed, there is sap existing in some part or other of the stem, and the slight movement—if movement it may be termed—is certainly upwards, not downwards. In inorganised objects the law of development is more easily discoverable than in organised beings. The development of a crystal, in a solution which contains crystalizable matter, is more easily ascertained than is the growth of a plant or of an animal; because in the former, viz., the mineral, the process will go on regularly, continuously, and as long as the solution is supplied. In the crystal, there is no law of limitation either of space or duration, except the non-supply of matter in a state of solution, *i. e.*, capable of being added to what was previously formed. Plants and animals are limited in their growth by laws peculiar to themselves, and these laws are not affected by the supply of food and room for development. We find that every living being is subject to laws which vary with the varying idiosyncrasies, peculiarities, or properties of every species. For example, the annual plant only flowers once during the whole period of its existence; the shrub never becomes, under any circumstances, a tree, and trees vary as much from each other as shrubs vary from trees. We certainly do not approximate to the cause of this variation by simply stating that a certain tree or plant, or class of trees or plants, assumes such a size, form, structure, &c., simply in obedience to the law of its own being. We are unwilling to admit our ignorance of the causes which produce these varying results, and we strive to hide it often under a surplusage of words—vague, indefinite generalities, which mystify, but convey no clear, intelligible notion to the mind. The formation of cells, of vessels, of tissues of all sorts, of pith, wood, or bark—of flowers, fruits, and seeds—all are alike obscure and incomprehensible. The legitimate object of science is to announce facts—to observe phenomena—to show the relation between the means and the end—to explain, as far as possible, the admirable arrangement of the different parts, which so harmoniously concur in producing certain results—to trace their mutual dependence on, and perfect adaptation to, each other. There are mysteries in nature as there are everywhere else;

there are limits to the *knowable;* there is an instrumentality, a power and capacity in living organised objects which the keenest eyes, and the most powerful microscopes, never will detect; and the time, talent, and energy wasted in vain efforts at explaining the incomprehensible, would, if applied to the observance of facts, and the investigation of phenomena, speedily rescue natural science from the reproach of being only the science of theories, systems, mystifications, and logomachies.

87. *Physiology of the Reproductive Organs.*—The outer and inner floral verticils, or the calyx and corolla, usually termed the non-essential parts of the flower, are the external envelopes of the stamens and pistils. The term non-essential organ is not scientifically exact, nor, philosophically, quite accurate. If non-essential, why is it present in most plants?

It is not universally present in all plants. The cell is the only organ universally present in all plants, and it forms the sole constituent of half the Cryptogams. If universal presence in every individual of the vegetable kingdom be the test of essentiality, the stamens and pistils are non-essential, for they are absent in a third part of known plants. It is unphilosophical to call these envelopes unessential, for nature forms nothing in vain—nothing which does not contribute to the preservation or reproduction of the individual of which it forms an essential part. It is more correct to say that a calyx and corolla are not necessary to all plants. The cell, as above stated, is absolutely necessary to all plants, but it is never stated that the *elaters, spirals, vascular,* or *woody bundles,* &c., which are not universally present, are not essential to the economy of the plants wherein they are produced. Again, a large number of plants produce reproductive bodies without the intervention of stamens and pistils. The outer envelopes are protective of the more tender parts of the blossom, and are to be considered as indispensable organs wherever they are found—as necessary to the production of fruit as leaves are necessary to the vegetation and maturity of the plant. The calyx is oftener persistent than deciduous. All monosepalous (gamosepalous) calyxes are permanent; and they are persistent in several orders where the calyx is parted. It is persistent when it is superior or above the ovary. In this case it forms a crown to the fruit. In certain orders of plants, where the ovary is more or less connected with the calyx, the latter constitutes part of the fruit, as in the *Rose, Gooseberry* and *Apple,* and is consequently persistent. The corolla, after impregnation, decays, and either falls off, or withers upon the organs of fructification, or on the fruit. The corolla is never permanent, as the calyx often is, viz., in a vigorous or vital condition. The calyx, when persistent, never withers, but becomes part of the fruit, or serves for a protection to it. The corolla, when persistent, is always so in a withered or dead condition. The stamens and styles, though generally contiguous and surrounded by the corolla as with a fence, are sometimes on distinct parts of the plant. In the *Carices,* and in many of the other genera of *Cyperaceæ,* the stamens and styles either are on different spikes, or on the same spike; but always more or less distinct, though on the same plant. In the *Salices* and other *amentiferous* genera, the stamens and styles are on different plants. It is generally believed that the pollen-grains are necessary for fertilising the ovules; though there are some examples of female blossoms, as they are called, bearing fruit and seed without the interposition of the pollen-grains. But a few exceptions cannot be considered as decisively contradictory of the general fact, that bodies of both kinds are present (both stamens and styles), and that both are necessary.

There is a more important question now agitated in relation to the pollen-grains, viz., whether they are the real parents of the future plant, or only the means of fertilising the ovules. Schleiden and some other German botanists maintain, that the pollen-grain, or cell, is analogous to the reproductive cell in Cryptogams, with this difference, that while, in the latter, the germinating cell falls on the ground, and is capable of reproducing a plant like its parent, the pollen-grain requires such a medium as the ovule is stated to be, wherein it is developed into a state intermediate between the original pollen-cell and the development of the embryo; or, in other words, that the pollen-grain becomes the embryo, but only through the intervention of the ovule, and that it is capable of existing in this condition a longer or shorter period. It is to be hoped that this is not a dispute about a point which probably cannot be decided in favour of either view. The subject is confessedly very obscure, viz., whether the seminal matter in animals, and the pollen-grains in plants, are the rudimentary embryos in either case respectively, or whether the embryos are only fertilised by the seminal matter or pollen-grains; or, in other words, as above stated, whether the pollen-grain or the ovule is the parent of the future plant.

88. *Physiology of the Embryo.*—The reproductive cell, or spore, of cryptogamous plants would, in all probability, soon lose the capability of germination, if it did not find a medium suitable for its development. The embryo of phænogamous plants can retain its vitality for a greater or less period in the state of seed. Some seeds are reported to have germinated hundreds and thousands of years after their production on the parent plant. Mummy wheat is said to have grown after an entombment of more than three thousand years. Other astounding facts are asserted about the duration of vitality in seeds when excluded from atmospheric influences; and several of these are grounded on good authority. By others these facts are questioned, and, *prima facie*, they appear so very extraordinary as to require the strongest confirmation. It is well ascertained that some seeds resist decomposition for long periods, especially if they be protected from moisture, air, and light. When subject to these stimulants, they either germinate, or are decomposed into their original primary constituents. Every perfect seed contains within itself sufficient nutriment for its development, till it is in a condition to absorb nutriment from the soil, or the medium on which it is destined to grow, and to fulfil its destiny in the general economy of nature.

89. Most plants, like animals, decay and perish from the effects of age, and only a very few species prolong their existence beyond the space of from two hundred to six hundred years. Some trees are very tenacious of life, as has been already stated; but, after certain definite periods, all plants, even those most remarkable for longevity, decay and perish, either through the rupture and consequent destruction of their internal organisation, or from the effects of accidents, injuries, atmospheric influences, &c. Like other organic objects, they are finally resolved into their constituent elements. It is easy to foresee, that soft, cellular substances, as Funguses are, cannot have so protracted a duration as the Oak or the Yew, under the shade of which they are produced. The mystery consists in the fact, that carbon, oxygen, hydrogen, &c., are the elements or bases of both the Fungus and the Oak. All we can ascertain is, that these constituents are differently combined in these very dissimilar objects.

90. *Duration of Plants.*—Many species of plants complete the term of their existence as organised beings in a few weeks or days; some of the Fungi in a few hours. Others are as remarkable for the great extent of their duration. There are trees of exotic growth that are believed to have been growing for thousands of years. Our Yew trees, the natural growth of our chalk-downs, and the venerable living occupants of many of our churchyards, are known to be of a great age, and have the appearance of almost perpetual duration, the principle of vitality being so strongly exerted by every part of them, from the root to the topmost branches. Many Oaks, Chesnuts, &c., are also ascertained to be of great longevity—to have been in existence during hundreds of years. The common division of all plants into *annual*, *biennial*, and *perennial*, is, in some respects, vague or indefinite. Many species of acotyledonous plants, Fungi and Algæ, for example, spring up from spores or sporules, vegetate and produce other spores or sporules in a few hours or days; only a few last a month, and very few exist more than a few months. There are plants of the *Alsinaceous* section of the order *Caryophyllaceæ* that vegetate and produce seeds in a few weeks. They certainly produce seeds early enough in the season to vegetate, and bear a second, or probably a third, crop in the course of a season. The division into annual and biennial is inconvenient, inasmuch as every annual that can bear a mild winter, may become biennial merely from the accident of dropping its seed late in the season, when it could not produce its flowers nor mature its fruit, although it might have done both, if the seed had been deposited at an earlier period. Still the plant may be very properly denominated an annual, if its general economy be to produce fruit (seed) within the year, if sown in proper time. A strictly biennial plant does not produce fruit in the same year when its seeds are deposited in the ground. It may resemble an annual so far, that when late sown it will produce flowers and fruit as soon as a late-sown annual; but it always (generally) requires two seasons to accomplish the object of its being (creation). Therefore the cultivated *cereals*, Wheat, Rye, Barley, Oats, &c., are not necessarily biennials;

though they are sown before winter, and may be said to grow during a part of two seasons. The common Turnip is an example of a strictly biennial plant, which never produces a flowering stem, with flowers and seeds, before the second year of its existence, whether sown early or late. Cabbages, Coleworts, and their varieties, do not usually flower, when permitted, before the third year. The first year they are seedling plants; the second they afford leaves for culinary uses; and during the third year they shoot up a stem, and bear flowers and fruit. It is doubtful whether or not the *Cow Parsnep*, the *Wild Angelica*, the *Carum carui* (common Caraway), be biennial, or of longer duration. There is a plant of the *common garden Angelica* (Archangelica), in the author's garden, which is probably three years old, certainly two, and it has not yet flowered. A more scientific division of plants by duration would be into such as flower only once in their lives, *i. e.* never flower again, but perish after they have matured fruit, like the Carrot, the Parsnep, &c. Under this division it would be necessary to include the famous *American Aloe*, which is fabled to flower only once in a hundred years. It is a fact that it only flowers once in its life, and it may live to an indefinite period. All plants would thus be divided into—1st. Such as flower only once in their life, whether in their first year, second year, or their third year, or even in their sixtieth year; and, 2nd, Such as flower more than once before perishing, whether the duration of such be five, seven, or an indefinite number of years. It is a fact that annuals and biennials may become of several years' duration simply by preventing their flowering. Hence *Garden Parsley* (Petroselinum sat.) may be preserved for several years by cutting or pinching off the stems soon after they make their appearance. In conformity with long-established usage, the duration of plants described in this work is denoted by the term *annual*, when the plant, under favourable circumstances, generally flowers during the first year of its life; and *biennial* when it does not flower before its second, or even third year, provided that it flower only once, and that not generally within the first year of its existence; and *perennial* when it flowers oftener than once, even though its whole duration may be shorter than those denominated *biennials*.

MORPHOLOGY.

91. *Morphology* treats of the formation, shape, and position of organs. The primary organ of every plant is the cell, as already stated (sect. 2). This is composed externally of *membrane*, internally of *fibre*, or viscid, granular matter, deposited on the inside of the cell-wall. From this elementary organ all the varieties of tissue are produced. The primary cell or cells are capable of reproducing similar cells, either externally, in which case the original or mother-cell exists with the produced or daughter-cells, or a series of cells are produced internally;

and, in this latter case, the original cell perishes, or is absorbed by the others. The simplest forms of vegetation are entirely cellular. The Snow plant (*Protococcus nivalis*) consists of a congeries (mass) of simple cells. In *Vaucheria*, another *Algal*, the cells are simple, as in Protococcus, but differ from those of the latter in being elongated or lengthened. These two facts, the round or rounded shape of the cell in *Protococcus* and the elongated shape of the cell in *Vaucheria*. illustrate the morphology of the simple organs, proving the identity of principle or origin in the cells of these two genera of *Algæ*. Science is unable to assign a reason why the cell in the one is spherical or polygonal, and in the other cylindrical and elongated. The power of vitality resident in living organisms is usually adduced in support of every obscure phenomenon, either of animal or vegetable physiology. Why the same organic constituents should assume such infinite diversities of form, structure, and development, is yet a mystery. Science can only state the facts.

92. *Morphology of the Simple Organs.*—There is a remarkable coincidence between the simplest forms of plants and the primary forms of all plants. The *Algæ*, *Fungi*, and *Lichenes*, or the class *Amphigens. Endl.* consist of a series of repetitions of the same simple organ or organs, being homogeneous or similar in their structure, nearly as much so as an inorganised object. One portion will be a tolerably exact representation of any other. These plants have no external organs, neither root, stem-leaves, nor flowers, and hence they may be called inorganised. They are either amorphous (without definite form), like many *Fungi* and *Lichenes*, or they have definite forms, like many of the *Algæ* and *Fungi*, though quite homogeneous in structure. In like manner, all plants in their origin are wholly cellular and homogeneous in structure, and their organs, viz., the *radicle*, *plumule*, and *cotyledons* are rudimentary. In their nascent (growing) state they continue cellular. The vascular or fibrous tissues are developed subsequently to the cellular tissues, and as the plant grows its various organs are progressively developed till it reaches maturity.

In the lowest orders of plants, viz., *Amphigens. Endl.* (Algæ, Fungi, Lichenes), the whole plant is composed of cells; and in this respect these three orders are analogous to the embryonic or rudimentary state of plants belonging to the higher orders.

93. In *Hepaticæ*, *Musci*, *Filices*, and the other higher orders of Cryptogams, a more complex organisation is observed. *Elaters*, *vascular tissue*, and woody fibre appear among the simple internal organs, and there are rudimentary stems, leaves, and spore-cases among the compound external organs. The plants of these orders have, therefore, some considerable analogy to the more perfect plants while growing and only advancing to maturity.

94. *Morphology of the Compound or External Organs.*—The external or compound organs—viz., the root, the stem, the leaves, the flower, the fruit—with their several appendages, constitute, morphologically, two systems of organs, or are reducible to two normal forms. The *axial organs* comprehend the root, the stem, the branches, if present, the

peduncle or pedicel, the torus or disk, the stipe of the ovary, if present, and the podosperm, or stalk of the seed. The *lateral organs* include the leaves, the bracts, if present, the calyx, the corolla, the stamens, and the ovary or carpellary leaflets. It is evident that the stem or axis is the medium of communication or of connexion between the root and the leaves, the flowers and the fruit. The root may be regarded as a downward prolongation of the stem, as the peduncle, the flower and the fruit are an upward elongation of the same organ. The normal form of the root is cylindrical, more or less tapering, and, like the stem, protruding lateral shoots, sometimes from just below the collar, sometimes from the middle, or a little below the middle, and occasionally from the very extremity of the root. This property is also characteristic of the stem. It is either branched from the very root, or from below, or above the middle, or only at the very top: the former state of the stem is characteristic of shrubs; the latter states are the normal forms of trunks of trees. The fibrous root differs from the perpendicular, or tap root, exactly in the same manner as the stem or stems of a shrub differ from the normal form of the stem of arborescent plants. The fibrous root emits a tuft of fibres immediately *below* the crown of the root; and the shrub throws out a greater or less number of branches from a point just *above* the crown of the root.

95. Many roots are, in their structure, allied to stems. For example, the roots of trees and shrubs (dicotyledonous trees and shrubs) have distinct wood and distinct bark. In their position and functions they are distinct from stems; but in structure and even in form, they are analogous to stems. As the stem is the medium of communication between the root and the superior organs, the root is the medium of communication between the earth and the stem. Some herbaceous plants have roots which are also very much like stems in structure. For example, many umbelliferous plants have roots, which like the Carrot and Parsnep are furnished with distinct bark. Several cruciferous plants are like the Turnip, in which there is a bark or rind quite distinct from the internal part, and differing from it in taste as well as in structure. The direction of the root normally coincides with that of the stem, the only difference being that the tendency of the root is downwards, while that of the stem is upwards. The aberrations from the normal type or form of the root are probably not more numerous than they are in the stem. The position or direction of the root is, of necessity, more modified than the direction of the stem is, because the former is developed in a medium very different from that in which the latter grows. These modifying circumstances the root has no possibility of controlling. At a greater or less depth from the surface of the earth the soil is always hard, both impenetrable by the tender fibres of the root, and incapable of yielding any nourishment to the plant. Hence the branches or fibrous parts of roots are compelled to assume a more or less oblique or even horizontal direction, being unable to penetrate in a position exactly opposite to the stem, and also being unable to extract nutri-

ment from the soil in that direction. Roots are materially influenced by temperature and exposure, as well as by the soil and the obstacles in it that hinder their development in a normal direction; yet, even when they manifest a tendency either to rise to the surface, where the soil is generally more fertile, or to traverse long distances to reach water, the direction of the rootlets or fibres of the root are always downwards towards the earth's centre.

96. Branches are precisely analogous to stems, each branch becoming a lateral axis, and constituting another and distinct centre of vegetation. The peduncle, as above stated, is merely a continuation of the central axis, and constitutes the axial organ on which the different parts of the flower and of the fruit are arranged exactly as the leaves regard the stem and branches as their axis; the calyx, corolla, and other floral verticils surround their torus and axis as their respective centres. Sometimes the stalk is reduced to a peduncle, in which case the leaves, if present, are radical, and the flowers may be single (solitary) or several, either in proximity or spreading. The Dandelion, Cowslip and several Compositæ illustrate these modifications of the stem, and also this character of the inflorescence.

97. The lateral organs are the leaves, the bracts, the sepals, the petals, the stamens, and the carpellary leaves or leaf (ovary). These organs all correspond in their structure, their shape, and their position; they are all, more or less, thin flattened expansions, mostly composed of cellular tissue and some fibre, with a greater or less horizontal divergence, and always regarding the stem as their centre and axis. The leaf, and especially the leaf-stalk, has a considerable analogy to the stem or branch, and especially when the latter is in a green or nascent condition. In a recent state, both are chiefly composed of cellular tissue covered with an epidermis, with or without epidermal appendages, and both are provided with stomata. When these are present on the leaves they are also present on the young stem or branch. The midrib of the leaf or the petiole, if present, coincides with the stem in structure and functions. It is composed of bundles of vascular fibre, contained by cellular tissue; and so is the stem. The midrib or primary nerve, is a centre or axis of growth to the lateral nerves, as the stem is to the branches; and the nervation of the leaf, both in position and functions, corresponds with the branches of the stem. The angles of divergence are nearly of the same extent in both. The bark of the stem and the interstices or parts not occupied by the nerves in leaves, are composed of cellular tissue, and both have the cuticle or epidermal covering. There exists also between the leaves and stem a coincidence in functions, namely, that where no leaves are present, the stem, or at least the recently produced or green and juicy part of it, performs the operations of respiration and exhalation, which are the special functions of leaves, the stems in such instances being provided with stomata. Radical or root leaves are always arranged in a more or less complete rosette; they radiate from the crown of the root or from the apex of the underground stem, like the petals of a double Rose. In leafy aërial stems the normal position of the leaves is

opposite (viz., one on each side of the stem, from the same point of it), or alternate (on opposite sides of the stem, but not opposite to each other, there being an internode between single leaves), or scattered (where the leaves are arranged on all sides of the stem, some nearly opposite, and others alternate, as in the common Toad-flax). When the stem is abruptly shortened, or its growth interrupted, alternate leaves become opposite and whorled, as in several Rhododendrons. In *Lysimachia vulgaris* there are opposite, alternate, and whorled leaves on the same individual, caused either by vigorous growth in the stem, or by an interruption to its development. When this interruption occurs towards the end of a branch the leaves are tufted or in a rosette. This is the natural situation of the leaves in the Purging Buckthorn. In the sub-order *Stellatæ* the normal condition of the leaves is whorled. See *Galium*.

98. *Bracts.*—Except in position there is no difference between *bracts* and leaves. In the axils of the latter, leaf-buds are produced, and flower-buds are produced in the axils of the former (bracts); the bracts are consequently situated higher up on the stem. The leaf-bud produces several leaves on an elongating axis, which subsequently is developed into a branch. The flower-bud, on the contrary, is not elongated: but its extension is interrupted, and the various whorls of which the flower is composed, assume an opposite and whorled, instead of an alternate, position. The first series or whorl is termed the *calyx*, the leaflets of which differ from true leaves only in being smaller, and occasionally less or more coloured. The first series is the lowermost in position, and is also the outermost of the floral whorls (verticils). The annexed diagram shows the position and arrangement of the several whorls of a perfect or normal dicotyledonous flower. The outermost or lowest series, *a a a a a*, represents the calyx, which consists of five sepals, either distinct or coherent. The second series, *b b b b b*, represents the five petals of the corolla, either in a state of separation or of cohesion. The third series, *c c c c c*, represents the five stamens; and *d d d d d* the five capellary leaflets, which unite by their edges in the centre, and form the five-celled ovary. The normal number five is present in a perfectly regular flower, each of the verticils consisting of five separate or coherent pieces; and the arrangement of the several whorls is also normal (symmetrical). The petals are placed alternately with the sepals; the stamens alternate with the petals, but are opposite to the sepals; and the carpellary leaflets are alternate with the stamens, and opposite to the petals. Five is the normal number in decotyledonous plants, and this is the law by which they are arranged. The numerical law is often modified by adhesion, abortion, and redundancy. First, the sepals and petals may form a monosepalous (gamo-

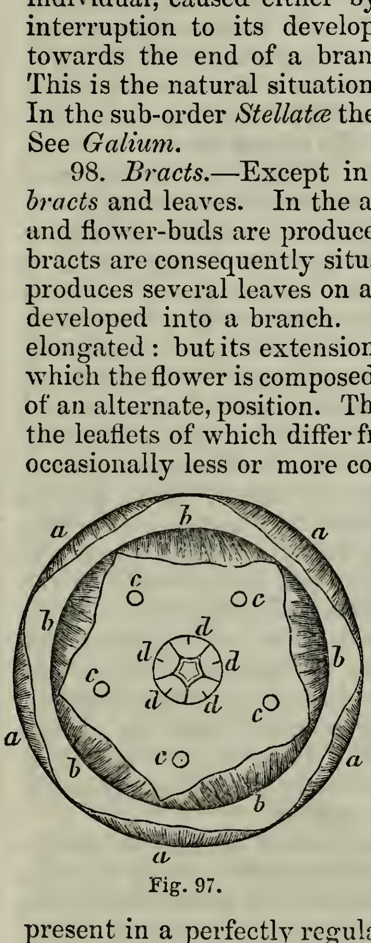


Fig. 97.

sepalous) calyx, and monopetalous (gamopetalous) corolla, or two of each only may cohere, and thus a tetrasepalous and tetrapetalous flower will be the result. One member of a series, as a sepal or petal or stamen, may be abortive, and the result will be the same, as the union of two sepals or of two petals. An addition may be made to the normal number by the splitting of one or more organs, or the organs may be increased by redundancy, when one or more individual organs are added to the normal number, or when an entire series or whorl is added. This is the case in some double flowers, where the increase of supernumerary organs is not occasioned by the degeneration of the stamens, but is a positive addition to the normal number of petals.

99. This explains what was before stated as a distinctive mark of dicotyledonous plants, that the normal number is five; but it is sometimes diminished by a suppression of one-fifth of any one or all of the series, and the tetrasepalous, tetrapetalous, tetrandrous, tetragynous flower is the result, or there may be a suppression of three-fifths of one series of organs—the stamens, for example; and the diandrous flower is the result, as in Veronica, in which there is also a suppression of one-fifth of the number of sepals and petals. An addition of one-fifth or two-fifths of the normal number of stamens will constitute a hexandrous or heptandrous flower. Most of the floral whorls are occasionally accompanied by supernumerary whorls. The calyx has an *under calyx*, or double calyx in *Malvaceæ*, in part of *Rosaceæ* and *Convolvulaceæ*. This may be regarded as a supernumerary whorl to the calyx. The corolla is often susceptible of several supernumerary whorls. It is probable that this is oftener the cause of double flowers than the degeneration or change of stamens and pistils into petals. The number of stamens is still more frequently increased by supernumerary development than the corolla is, and the increase in the number of these organs is often caused by an additional whorl. This is the case in decandrous plants, and still more so in icosandrous plants, where the stamens are indefinite, but arranged in several whorls. Supernumerary pistils are present in many flowers, as *Rubus*, *Potentilla*, *Ranunculus*, &c. In monocotyledonous plants the normal number is three, as has been stated (sec. 41). Here also the number is modified by abortion, coherence, and the development of supernumerary whorls, &c., as in the dicotyledonous species.

100. When one of the floral envelopes (calyx or corolla) is suppressed, the flower is said to be *monochlamydeous* (having but one floral envelope). In this case the floral envelope is usually called the *perianth*, or the *perigone*, when the blossom produces only either stamens or pistils separately. When both envelopes are suppressed, the flower is *achlamydeous* (without a perianth). When only stamens are produced on one part of the plant, and only pistils on a distinct part, or when these interior floral whorls are on separate, and more or less distant parts, the plant is termed *monœceous;* if the stamens and pistils be on different plants, the blossoms are termed *diœcious*. The arrangement of the floral whorls is frequently irregular, by the suppression or abortion of some of the usual whorls, or of the super

numerary whorls. For example, if the stamens be opposite to the petals, as in *Primula*, it is conjectured that there is one row of stamens suppressed, which suppressed row is supposed to be (should be) alternate with the petals (lobes), and the existing row alternate with the outer suppressed one, which was (would have been) normally arranged. There is some plausibility in the conjecture of a suppressed row of stamens and the teeth which crown the tube of the corolla in this genus may be abortive stamens. Barren stamens are not uncommonly associated with antheriferous stamens, and their arrangement is regulated by the same law of alternation, which appears to be the principle on which all the floral organs are arranged. The petals differ from the sepals chiefly in their more delicate appearance, in their vivid colours, in being the general scent-receptacles of the plant; but in their structure, position, and functions, they are perfectly analogous to the sepals. Their position is above the calyx, and when the latter is developed, they are in its interior. This, however, is not always the case; the calyx is reduced to a mere rim in certain orders, as *Valerianaceæ*, and in some genera of *Compositæ*. It is developed as minute teeth in many *Umbelliferæ*. In becomes linear segments in *Onagraceæ*. The stamens differ in shape and functions rather than in structure, from the external envelopes. This being the fertilizer of the ovules, is reckoned the most important floral organ. The superior or innermost floral organ, the pistil crowns the stem, and terminates its growth in that direction.

101. *Morphology of irregular Floral Envelopes, and of the Stamens and Pistils.*—The irregular monopetalous corollas usually assume the *bilabiate*, or the *ringent*, or the *personate* forms. All these forms originate in the cohesion of the petals, three forming the lip or lower limb, which is more or less three-cleft, or with three notches. The upper is formed of two cohering petals. The bilabiate corolla differs from the ringent or gaping corolla only in having the lips nearer each other. In the ringent form they separate widely, as in *Rhinanthus* and *Pedicularis*. The personate corolla has a very prominent palate which closes the throat. This form is exemplified by *Linaria vulgaris*, the *great Snapdragon*, &c. The law of alternate arrangement is prevalent in corollas and calyxes formed by the union of the petals and sepals. The bilabiate calyx has its upper lip formed of three sepals opposite to the two petals, which form the helmet or upper lip of the corolla, and the position of the latter is alternate with that of the former. The two sepals composing the lower lip of the calyx are opposed to the three petals forming the lower lip of the corolla, thus preserving the law of alternation in their arrangement.

In one of the sub-orders of the *Compositæ*, viz. *Cichoraceæ*, many or most of the flowers (corollas) are ligulate (strap-shaped), connected at the lower part or base, and forming a short tube, and an elongated linear limb, five-toothed at its margin. This is another example of the cohesion of five petals, forming a monopetalous corolla, the two exterior petals being only united just at the base. Irregular polypetalous corollas are chiefly present in the orders *Ranunculaceæ*, *Fumariaceæ*, and *Leguminiferæ*. In *Helleborus* the petals are folded and shaped like a horn; in *Aquilegia* they are hooked at the base, and hollow. They form long-curved tubes in *Aconitum*. In *Fumitory* the petals are gibbous (swollen or enlarged) at the base, and two of them cohere by their margins, near the extremity. In *leguminiferous* plants the upper lip is much enlarged, and the two lower ones are often coherent. This form is termed the *papilionaceous* corolla, from its fancied resemblance to the wings of a butterfly (*Papilio*). In several orders and genera, as *Violaceæ*, *Linaria*, &c., one of the petals, or more than one, bear a spur at the base.

102. In several orders the stamens adhere by the base of their filaments, forming three or more spreading tufts, as in *Hypericaceæ*. In *Leguminiferæ* nine of them are often connected by a web-like process, which extends nearly to their tops, while the remaining one is free. In *Malvaceæ* and *Geraniaceæ* all the stamens are connected by a membrane, which closely invests the styles. In *Compositæ* and *Violaceæ* the anthers are united, forming a tube, which closely embraces the style (*Syngenesious*). In *Salvia* the stamens are cleft, one of the branches only being fertile or antheriferous. In some plants, as, for example, in the White Water Lily, the petals either become stamens, or the stamens degenerate into petals, and the transition is so gradual that it is scarcely possible to distinguish the one set of organs from the other, or to ascertain where the one ends and the other begins. The structure of the pistil is affected by the same causes, whatever these may be, which occasion adhesion, abortion, or multiplication of the other series of organs. It has already been stated that the appendicular organs, as prickles, hairs, spines, tendrils, &c., are but modifications of the cuticle, the branch, the leaf, or midrib, &c. The science or study of aberrations from the normal type, *i.e.* of abortions, suppressions, or non-development of organs, multiplication of parts, degeneration, or the mal-formation of parts, division of parts, &c., is called Teratology (τερας, a monster, and λογος, treatise).

103. Morphology neither can explain, nor does it profess to exemplify, the change of one organ into another: as for example, the change or transformation of a stamen into a petal, or *vice versâ*. On the contrary, it is a universally received law, that a leaf never becomes a petal,—that a stamen never becomes a pistil. A leaf, or modified leaf (scale or bract), may supply the place of a corolla or petal, as in the amentiferous orders. Both anthers and stigmata are sometimes borne on the same column, as in several orders, and among others in the Orchids. But these organs never were developed in the normal state of leaves, filaments, and styles. Morphology treats of modifications of formative power, not of the change nor even of the modifications of organs. That part, which under ordinary circumstances might have been developed by the formative energy of the plant as a leaf, may, under a change of circumstances, become, by the same power, a sepal or petal, a stamen or a pistil. Practical florists, by a certain treatment, can accelerate or retard the flowering of plants; or, in other words, may, by withholding manure and water at certain periods in

the life of the plant, cause it to produce flowers at a point where it would, if abundantly supplied with nutritious matter, have produced leaves and a more lengthened stem. The cultivated oat often produces several leafy stems, sometimes from ten to twenty, from the same root, and some of the panicles may be from twelve to eighteen inches long, bearing not scores, but hundreds of individual grains. In poor, sandy, dry soils, there are some plants of oats occasionally found which bear one leaf on the stalk, and the stalk bears only a single grain. This not uncommon fact is an illustration of what is properly understood by morphology—a formative energy modified by circumstances. In an ordinary field each grain of oats produces a single stem, with from four to six leaves, and as many joints (internodes), with a panicle eight to twelve inches long, with from sixty to a hundred grains. In rich fresh land, where the plant had room to tiller (branch at the root), several leafy stems are usually produced, each stem bearing from a hundred to a hundred and fifty grains. In very poor dry soils a single grain of oats never produces more than one stem, and stems bearing from one to six grains. The formative energy resident in seeds of equal qualities is thus modified by external circumstances, which the plant is incapable of controlling.

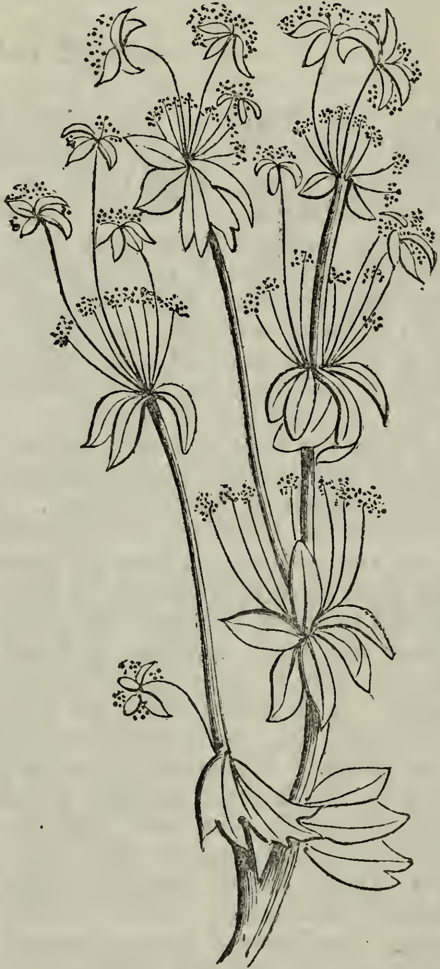


Fig. 98.

The cut in the margin represents a small portion of a specimen of *Apium graveolens* (Common Celery). The primary rays of the umbel, instead of bearing the umbilele or partial umbel, as in the common form, assumed a branch-like form, bearing only partial umbels and single flowers, with enlarged bracts.

GEOGRAPHY OF PLANTS.

104. *Distribution of Plants in relation to Soil and Situation* (*habitats*).—Many species of plants, and some genera, are limited to certain kinds of soil. Some Ferns, as *Asplenium septentrionale*, grow only on trap, basalt, and similar sorts of rock. *Polypodium calcareum* seems to be confined to limestone districts. The *Orchids* are the most remarkable examples of species and genera, mostly restricted to cretaceous and calcareous soils. Several of these beautiful objects are only to be found on chalk, as *Ophrys arachnites* and *O. aranifera;* some grow both on chalk and limestone, as *Ophrys apifera* and *O. muscifera;* and some are found on most soils indifferently, as *Orchis morio*, *O. mascula*, and *O. maculata.* In the orchid family the plants which have the most extensive range, and which grow on the greatest number of soils, are the most numerous as individuals, and grow in the greatest number of distinct places. The most beautiful of all the British Orchids, *Lady's Slipper* (Cyp. cal.), is confined to the limestone, and but two or three stations are known where it grows, and only a single plant or so is to be seen at any one time. The *O. arachnites* is limited to one or two localities in South Kent. The *Bee and Fly Orchises* are more common, and are often found in considerable numbers. The *O. mascula*, *O. maculata*, and *O. morio* are much more common. A particular soil is not essential for them, but particular localities are, viz., woods, commons, heaths, meadows, and other undisturbed places. *Orchidaceæ* is the only order that, for the most part, prefers the chalk and limestone; that is, more species grow on such soils than on all other soils together. Besides the Orchids, which prefer chalk, limestone or marl, the following genera—viz., *Paris*, *Taxus* (Yew), *Fagus* (Beech), *Buxus* (Box), *Thesium* (Toadflax), *Origanum* (Marjoram), *Chlora* (Yellow-wort), *Phyteuma* (Rampion), *Caucalis* (Bur Parsley), *Daucus* (carrot), *Libanotis* (Mountain Parsley), *Delphinium* (Larkspur), *Adonis* (Pheasant's-eye),—prefer chalk, though some of them are occasionally found in marly or sandy fields. The following species are chiefly found on the chalk or limestone, besides the *Orchids* above noticed:—*Brachypodium pinnatum*, *Bromus erectus*, *Avena pubescens*, *Carex digitata* and C. *humilis*, *Ajuga chamæpitys*, *Galeopsis versicolor* and *G. Ladanum*, *Linaria repens*, *Verbascum Lychnitis*, *Lithospermum purpureo-cæruleum*, *Campanula Trachelium* and *C. glomerata*, *Gentiana amarella*, *Crepis biennis*, *C. fœtida* and *C. taraxacifolia*, *Cineraria campestris*, *Scabiosa columbaria*, *Galium tricorne*, *Asperula Cynanchica*, *Bupleurum rotundifolium*, *Petroselinum segetum*, *Pyrus Aria*, *Spiræa filipendula*, *Hippocrepis comosa*, *Anthyllis vulneraria*, *Onobrychis sativa*, *Linum angustifolium*,

Geranium columbinum, *Hypericum montanum*, *Arenaria tenuifolia*, *Cerastium arvense*, *Reseda lutea*, *Papaver hybridum*, *Anemone Pulsatilla*. Some of these species are occasionally found on other soils.

105. The following genera prefer limestone soils, viz.—*Achyrophorus*, *Meum*, *Trinia Actæa*, *Trollius*, *Polemonium*. The following species are most commonly found on the limestone, exclusive of the species of the above-named genera, viz.—*Gentiana verna*, *G. amarella* and *G. campestris*, *Carduus eriophorus*, *Rubia peregrina*, *Galium pusillum*, *Geranium sanguineum*, *G. sylvaticum* and *G. pratense*, *Silene nutans*, *Dianthus cæsius*, *Hutchinsia petræa*, *Draba incana* and *D. muralis*, *Cardamine impatiens*, *Arabis stricta*, *Thalictrum minus*. Some of these are found on other soils; but they are most abundant on the limestone tracts.

106. Most grasses prefer a light sandy soil. The *Ericas*, and kindred genera, love peat, or a sandy, peaty, moist soil. The *Oak* prefers marly clay, the *Hornbeam* a stiff, cold, damp clay. Most of the old Pollards in Epping Forest are Hornbeams. The *Pine* loves a gritty soil. The *Carices* (Sedges) seem to luxuriate in a soil which contains a considerable portion of iron. The *Droseras* require a peaty soil. Plants in general depend more on habitat (situation) than on soil; for example, more plants are confined to water, watery places (marshes), sea-shores, alpine and mountainous rocks, fields, meadows, heaths, woods, hedges, lanes (near houses), and road-sides, than are restricted to particular soils.

107. *The Fresh-Water Plants*—that is, such as grow solely in water, and those that grow in marshy or watery places—comprise a large proportion of the British plants. These two classes of plants are not susceptible of strict separation; for some of them are found sometimes in water and sometimes in marshy ground, as several of the *Carices* (Sedges) for example. Some grow by river-sides or ditch-sides, partly in water and partly on land. The agrarial or field plants grow also by road-sides and under hedges, where the soil is moved occasionally. Some of the sylvestral or woodland plants grow in hedges, also on heaths and commons. The plants that are classed under the terms sylvestral, paludal, aquatic, &c., have a preference for woods, marshes, water, &c.; that is, more of them are found in such habitats than in any other.

108. *Aquatics*—About one-thirteenth of the British species of flowering plants grow exclusively in water, viz., 1 species of *Equisetum* (E. limosum), 10 *Gramineæ* (certain species of *Glyceria*, *Poa*, *Catabrosa*, *Alopecurus*, *Leersia*, &c.), 8 *Cyperaceæ*. All the species of *Eriocaulaceæ*, *Typhaceæ*, *Lemnaceæ*, *Potamaceæ*, *Zosteraceæ*, *Alismaceæ* (A. ranunculoides always grows in water, though it often flowers. after all the water has left it; this is the case with *Alismaceæ* in general), *Hydrocharidaceæ*. One species of *Polygonaceæ*, viz., *P. amphibium*, flowers on the land, though it grows in water, and also flowers in this element. One species of *Primulaceæ* (Hottonia palustris), part of *Lentibulaceæ* (the genus Utricularia), several species of *Scrophulariaceæ* (Limosella aquatica, and Veronica Bec. and V.

Anagallis). One species of *Gentianaceæ* (Villarsia nymphæoides), 1 of *Campanulaceæ* (Lobelia dort.), 3 of *Compositæ* (Aster and Bidens, both species), 11 species of *Umbelliferæ* (viz., *Oenanthe* 5, *Sium* 2, *Helosciadium* 3, *Cicuta* 1); 11 of *Halorageæ* and *Onagraceæ* (Epilobium 2), *Caroyphyllaceæ* (Stellaria 2), *Cruciferæ* (Nasturtium 2), *Nymphæaceæ* (all the species), *Ranunculaceæ* (Ranunculus 4).

109. *Palustral* or Marsh Plants are such as grow in boggy places, exclusive of such as only grow where water has stood during winter, and which grow on firm grassy places, which are only occasionally flooded. Palustral or marsh plants grow where the situation is always more or less watery, having water above or just below the surface. The following are of this class, viz. :—

All the *Equiseta* except *E. arvense. E. Telmateia* and *E. hyemale* grow where the soil is more or less moist or close to water (for example, a bank under a hedge, with a watery ditch just underneath them). *Ophioglossum* often grows in marshy places, but it is not confined to such; yet it is scarcely found except where the situation is more or less moist. Several *Filices* grow in marshy places (for example, *Osmunda*). *Athyrium* (Filix foem.), all the varieties. *Nephrodium Thelypt.*, *N. cristat.* and varieties, are only found in boggy localities. Several species of *Gramineæ* (Glyceria, Arundo, 3 —Polypogon Alopecurus, &c.), all the *Cyperaceæ*, except about a dozen of the *Carices*, two or three of the Scirpi and Cyperi, and such as have been entered as pure aquatics, all belong to this section; also *Juncaginaceæ*. Most of the *Juncaceæ* delight in watery or boggy spots. The *Luzulas* generally grow in damp shady places, boggy or otherwise. Several *orchidaceous* plants prefer boggy places (for example, *Orchis latifolia*, *Epipactis palustris*, and the two species of *Bog Orchis*. The Orchids usually prefer a dry soil. Most of the Willows, and several of the other amentaceous genera grow best in a moist or rather boggy soil (for example, the *Alder*, the *Sweet Gale*, and the *Common Poplar*). Several species of *Polygonaceæ*, especially of *Rumex* and *Polygonum*, prefer watery or rather boggy places. *Rumex mar.* and *R. palustris*, also *Polygonum hydropiper* and *P. minus*, are always found in or near to water. Of *Chenopodiaceæ*, some are only found in muddy places by the sea, as Glasswort. *Sea Plantain* and *Sea Lavender*, and *Thrift*, may be also reckoned among the marsh plants. In *Primulaceæ*, *P. farinosa*, *P. scotica*, all the species of *Lysimachia* except *L. nemorum* (which also grows occasionally in boggy places) *Anagallis tenella*, *Centunculus*, *Glaux*, and *Samolus*, are marsh plants. The *Pinguiculas* are all what are termed bog-plants. Of the *Labiatæ*, the following grow in marshes or wet places—*Stachys palustris*, *Water Horehound*, and most of the *Mints*. Many of the order *Scrophulariaceæ* are found only in boggy places (for example, *Scroph. nodosa*, *S. aquatica*, and *S. vernalis*). The two former grow by river and ditch sides, and the latter usually, though not always, grows in wet hedges. Both species of *Pedicularis* are only found in bogs, especially *P. palustris*. *Veronica Beccabunga*, *V. Anagallis*, *V. scutellata*, and *V. serpyllifolia*, are only found in water